Traffic Safety

FORMERLY PUBLIC SAFETY

JUNE 1957

NEW in this issue

32-page RESEARCH REVIEW

A NATIONAL SAFETY COUNCIL PUBLICATION

WHAT DID THIS MAN PROVE?

TRAFFIC OPERATIONS

How Holiday Crashes Happen

PUBLIC SUPPORT

Ladies Day in Traffic Court

MOTOR TRANSPORTATION

Are Police Safe Drivers?

A NEW LOOK -and a new approach See page 8

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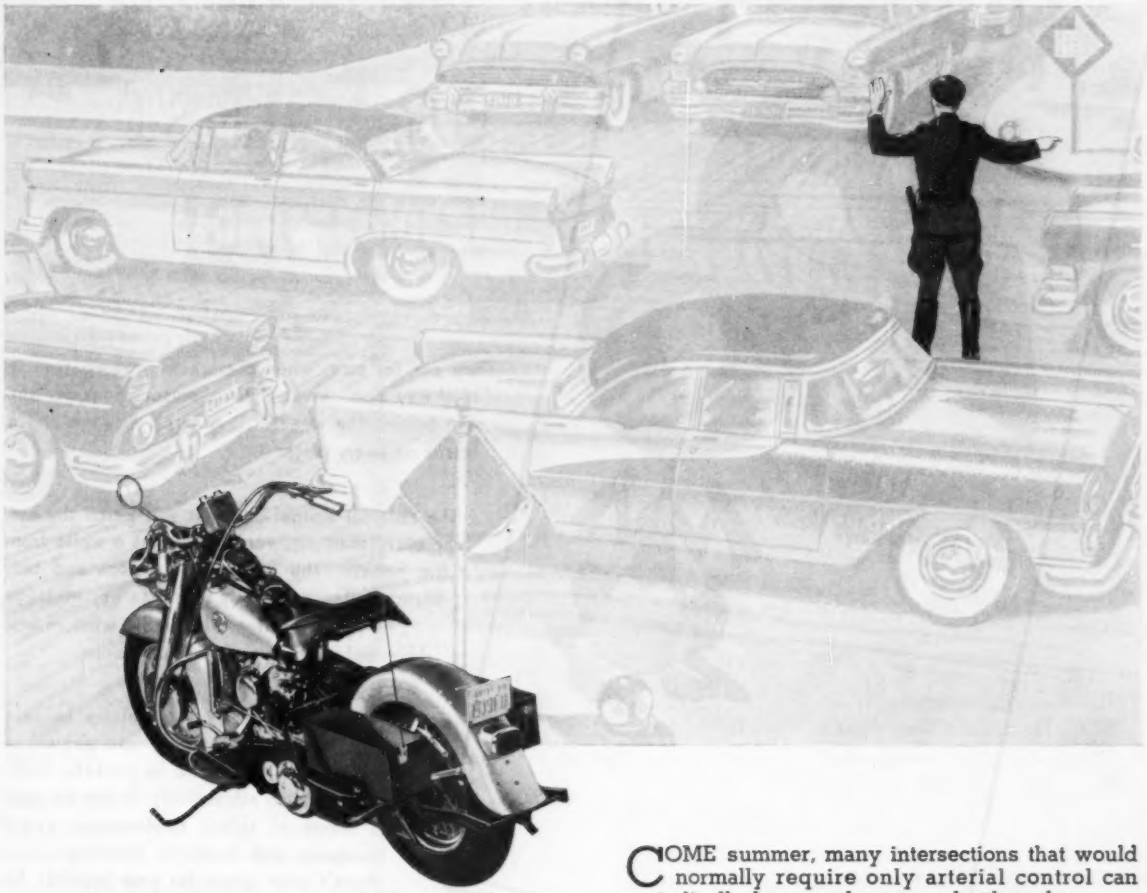

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NATIONAL SAFETY COUNCIL

425 North Michigan Avenue • Chicago 11, Illinois

Traffic Safety

FORMERLY PUBLIC SAFETY

A NATIONAL SAFETY COUNCIL PUBLICATION

Volume 50 Number 6 JUNE 1957

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TRAFFIC SAFETY is dedicated to the prevention of traffic accidents through the presentation of objective information and responsible opinion to official agencies, public support groups and the motor transportation industry. The views expressed do not necessarily reflect the beliefs or policies of the National Safety Council, but they are presented in the conviction that the pressing social problem of traffic accidents can best be resolved through freedom of expression and open debate.

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BETWEEN STOPS

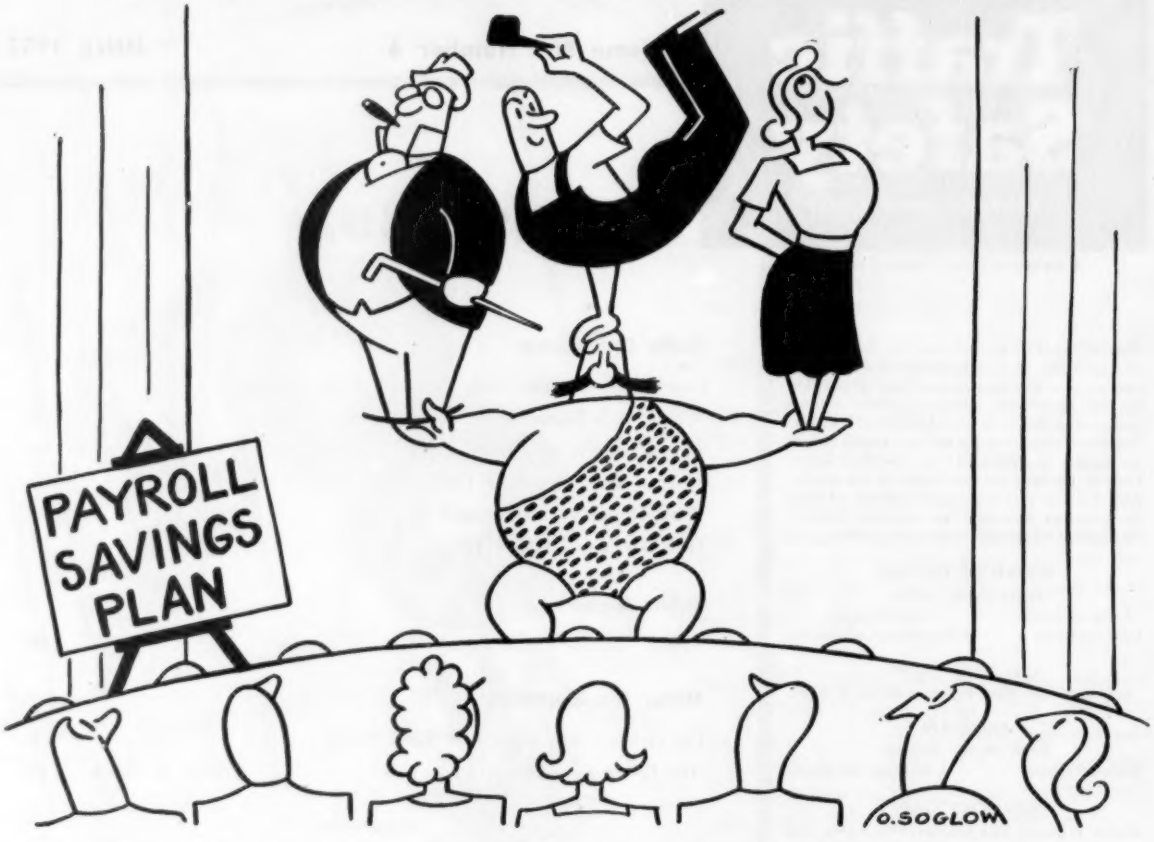
WE hope you like our new dress. It's spring and new togs and a jaunty look go with the season.

There have been times during the fitting sessions that accompanied our new look that we remembered the tag line of the tailor's story—"It's a good fit—all but the coat and pants."

But wait 'til we get going. The July issue will add up to 64 pages of magazine, and the next time the RESEARCH REVIEW is added, the magazine will total 96 pages. All, we hope, filled with the kind of articles and news you have been hoping for.

We're adding a mail bag feature to our July issue. So get in your letters. We will print the pros and cons as we get them with no holds barred. You can be complimentary or cantankerous. We'll love hearing from you in either case.

"Got A Load On Your Mind? I Haven't"



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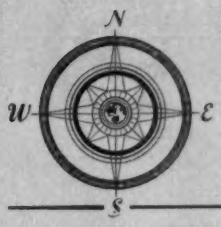


Today's Traffic

LOOKING AHEAD

Campus parking goes modern

Look for multi-story parking buildings, "desk side" parking, and underground facilities on college campuses of the future. Right now, the expense factor keeps such plans in the blueprint stage for most, though the problem of student parking gets tougher as enrollments increase in the auto age.

Since many large colleges and universities are located in cities—or adjacent to them—there's small chance of expanding surface facilities. The little land available is earmarked for athletic fields, new laboratories, dormitories, etc. Future parking must be up or down. Good example of this trend in action is the University of Minnesota.

Here's the answer

Ever been stymied by a question when presenting an Inventory Analysis? Then you'll welcome a new manual just issued by the National Safety Council. Prepared especially for staffs of state agencies who present Analyses in cooperation with the Council, the new book includes important information on all sections of the Inventory.

Boy Scouts plan safety good turn

New twist in the safety field is seen in the second point of the Boy Scouts of America's "National Safety Good Turn—1958." It reads, "To help arouse public concern of the adults of our nation about safety." The "Safety Good Turn" is the theme of the Boy Scout's National Service Project for next year. Traffic will be emphasized in March, April and May.

Death drop reason?

What is the reason for the early-year drop in the traffic toll? *Back the Attack-ers* see in it results of the stepped up official action and increased public support generated by the campaign. If *Back the Attack* impact continues throughout the year, they say, the 1957 toll will fall considerably short of the 1956 carnage.

Teens on bandwagon

Inventory reports across the nation show enthusiastic teen support of *Back the Attack*. Fresh ammunition for the youngsters' traffic safety drive is contained in the Operation Safety Youth Traffic Safety kit now available from N.S.C.

Help for adult drivers

The state of North Carolina is now providing an intensive, college-level driver education course (adapted to group needs) for all license examiners and all new highway patrolmen. Five 60-hour courses have already been conducted on the campus of the University of North Carolina.

Originator of the idea is Col. James R. Smith, commanding officer of the North Carolina Highway Patrol. Smith reasoned that even if every secondary school in the nation provided a top-quality driver education course to 100 per cent of

potential students, there would still be millions of licensed drivers permitted to operate vehicles without an adequate understanding and knowledge of the basic fundamentals of good driving. Training of special groups to help the motorist seemed to be the answer.

Collaboration with Dr. Albert Coates, director of the Institute of Government, University of North Carolina, followed. Result: the 60-hour driver education course for license examiners and highway patrolmen.

Billboard red herring

Controversy is building toward a climax in the Washington battle of the billboards, with the outcome still in doubt. The 41,000-mile interstate highway system is the prize, and both sides are bandying arguments in the name of traffic safety—that outdoor posters are a distracting hazard on the one hand, that they relieve monotony and thus contribute to safety on the other. Both arguments get pretty strongly into the area of opinion, since there is very little real evidence to support either view. The issue should be decided on its true merits, without using safety as a red herring.

Permits overdriving headlights

Proposed legislation in Missouri includes a bill that would establish maximum limits of 70 mph in daytime on all open roads and 65 mph at night, no urban speed limits being indicated, and would include a minimum speed provision. (Uniform Vehicle Code's minimum legal requirement for headlights is a forward illumination of 350 ft. According to the National Conference on Stopping Distance Charts, stopping distance for passenger cars traveling at 65 mph is 452 ft.)

New facts on speed

The National Safety Council's Committee on Speed has its new report in the draft stage. The report discusses the speed problem as a whole, and shows how the question of speed cuts across all segments of the Action Program. It is expected to get into such controversial areas as speed and horsepower, the use of governors to limit maximum speed, and the use of radar in enforcement.

Once over . . . not lightly

An advisory committee appointed by the American Association of Motor Vehicle Administrators is taking a critical look at the Periodic Motor Vehicle Inspection section of the Annual Inventory of Traffic Safety Activities. Object of the scrutiny is to up-grade the existing questionnaire so that it will give a more accurate picture of how a participating state's motor vehicle inspection activities stack up with the inspection requirements of the 1956 revision of the Uniform Vehicle Code.

U.S. slant for Rio traffic

Technical advice and assistance in traffic engineering and police traffic supervision is being given officials of Rio de Janeiro, Brazil, by the Traffic Institute of Northwestern University, under terms of a contract with the Institute of Inter-American Affairs of the International Cooperation Administration. Purpose of the six-month project is to formulate basic engineering and police supervision programs and assist Rio de Janeiro officials in the initial application of these programs.

CITIES FAIL TO HOLD LINE AGAINST TRAFFIC DEATH

March marks fourth month without increase

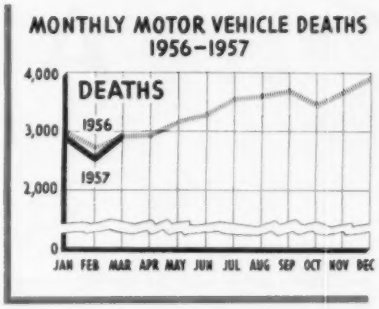
Cities are to blame for a halt in the downward trend of traffic deaths.

Cities, which had been pacing the race against traffic death in the first two months with a 13 per cent reduction, faltered in March and recorded a 3 per cent increase.

Despite the poorer performance in the urban areas, the traffic death toll for the nation held even in March, marking the fourth consecutive month in which fatalities totaled the same or fewer than in the corresponding month of the previous year.

The March total was 2,920—about the same as last year. It boosted the toll for the first three months to 8,320. That was 4 per cent under last year's three-month figure of 8,630.

The lower death tolls this year apparently were not due to any corresponding downturn in travel. Mileage figures are now available for January, and during that month, when deaths decreased 4 per cent, travel was up 9 per cent. The rate of 5.6 deaths per 100 million miles was the lowest ever recorded for January.



The March report revealed 21 states had fewer deaths than last March, two reported no change and 25 had increases.

At the end of three months, 29 states had better records than during the same period last year, only 18 showed increases and one reported no change.

For three months, deaths were still down 6 per cent in urban areas, despite the March increase.

Of 601 cities reporting March experience to the Council, 488 had fewer deaths or no change compared with the previous March. For three months, 439 of the cities still had fewer deaths or no change.

In March, 408 of the 601 reporting cities had perfect records. Of these, the three largest were Memphis, Tenn. (407,400); Norfolk, Va. (213,500), and Des Moines, Iowa (178,000).

For three months, 313 cities still had perfect records. The three largest

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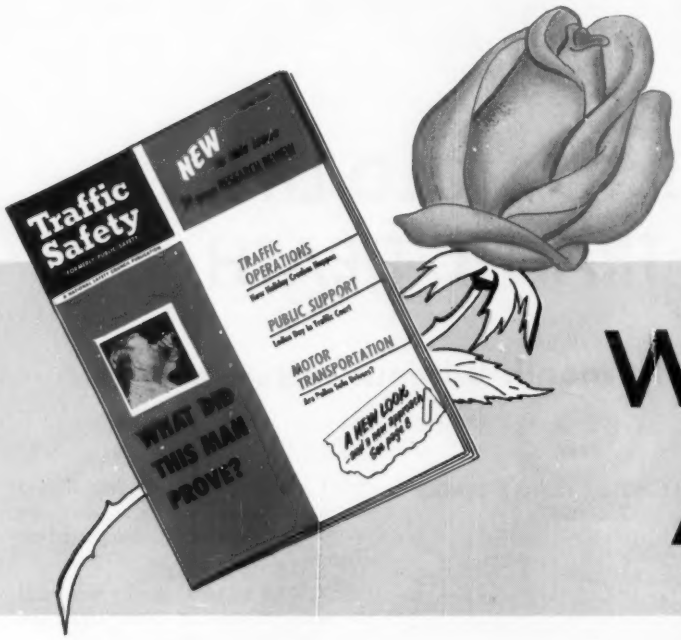
Here Are the Traffic Safety Leaders

Of those cities with fewer deaths at the end of three months, the following have populations of more than 200,000:

Norfolk, Va.	—100%	Washington, D.C.	— 30%
Syracuse, N. Y.	— 67%	Pittsburgh, Pa.	— 29%
Richmond, Va.	— 64%	Denver, Colo.	— 29%
Baltimore, Md.	— 55%	St. Paul, Minn.	— 29%
Memphis, Tenn.	— 50%	Milwaukee, Wis.	— 28%
Tampa, Fla.	— 50%	Portland, Ore.	— 24%
Boston, Mass.	— 47%	Philadelphia, Pa.	— 20%
Seattle, Wash.	— 47%	Chicago, Ill.	— 19%
Fort Worth, Tex.	— 43%	Detroit, Mich.	— 19%
Oklahoma City, Okla.	— 33%	Cleveland, Ohio	— 14%
		New York, N. Y.	— 11%
		Louisville, Ky.	— 8%

The 29 states with decreases for three months were:

Idaho	—35%	Georgia	—15%
South Dakota	—32%	Indiana	—12%
Nevada	—32%	Florida	—11%
Nebraska	—29%	Connecticut	—11%
Massachusetts	—24%	Ohio	— 8%
Colorado	—23%	North Dakota	— 8%
Kansas	—21%	Pennsylvania	— 7%
Michigan	—18%	North Carolina	— 5%
Maryland	—18%	Utah	— 5%
New Hampshire	—18%	Texas	— 4%
Tennessee	—17%	Maine	— 4%
Mississippi	—17%	New Mexico	— 4%
Iowa	—16%	New York	— 3%
Missouri	—15%	New Jersey	— 3%
		Louisiana	— 1%



WHAT'S IN A NAME?

Perhaps not much, really. A rose by any other name, and so on. But it gave us quite a pang to abandon PUBLIC SAFETY. We even had a twinge of guilt, as if we were turning our backs on our own kith and kin. After all, PUBLIC SAFETY had been a member of the National Safety Council family for a long time—30 years, in fact. So when we decided PUBLIC SAFETY was no longer descriptive of the magazine's contents, we found our logic getting all tangled up with tradition, and a comfortable feeling of familiarity, and all sorts of sentimental stumbling blocks.

However, we figuratively brushed away a tear, gulped a couple of times, and boldly went ahead—because a new name was a necessary symbol of a whole new concept we have for the Council's traffic magazine.

TRAFFIC SAFETY is our new name, and it's an honest and direct name to describe the contents of a magazine that we hope to make more and more interesting, useful and vital in the traffic safety field.

Along with the new name we acquired a new look. Take our new cover design, for example. We have been using photos of traffic scenes, but let's face it—there's nothing very pretty about a traffic jam. So, we said to ourselves, if we can't make our front door pretty, we can invite people into our magazine by making it easy to open. That's why our new cover is informative—you might call it a quick-glance table of contents—and an inviting latchstring to the many interesting pages within.

We won't bore you with shop talk about type faces or layout technique, but our new look all the way through the magazine is designed to help you get traffic safety information faster and easier in this hurry-up world we live in. We hope you do take time to read TRAFFIC SAFETY carefully—we think you will find much of value—but if you are so busy you can only hit the high spots, then we want those high spots easy to see and grasp.

A case in point are the newsletters formerly published separately by the Council. From now on "Today's Traffic," a press-time wrap-up of news and trends, and "Test Talk," the latest information on the chemical test front, will be a regular monthly feature of the magazine. "Brass Buttons" and "Good Morning, Judge," the police and court newsletters, will appear alternately.

This month marks the inauguration of the "Research Review," a 32-page quarterly supplement of research studies in the traffic field. We must admit that here is one new feature that doesn't fit our design for faster reading. Scholarly papers must be taken slowly, not at a gulp. But the "Research Review" intends to fill a long-felt need in the traffic field—pulling together into one place the results of research being done by many agencies and universities, often obscurely published, and not always easy to obtain even through facilities such as the National Safety Council library. Reprints of each quarterly "Research Review" will be made available.

And here is more big news! Beginning next month, TRAFFIC SAFETY will include as a regular monthly section of the magazine the "Operation Safety" service which the Council has published in kit form for the last 10 years. Many of the readers of the magazine also are subscribers to "Operation Safety" and are familiar with this invaluable public support program aid. To those of you who have not been receiving the kits, it will be an added bonus in the magazine.

All of the essential features of the "Operation Safety" service will be re-

tained—the planning guide, fact sheet, list of materials and sources, and a catalog page of posters, leaflets and other program aids that may be ordered from the Council. The newspaper and radio pattern material, including poster mats, can be obtained in a special free supplementary mailing on request. We are enthusiastic about this opportunity to provide TRAFFIC SAFETY readers with a unique traffic safety tool not available from any other source.

When you looked at our cover and our table of contents, did you notice that we have divided our editorial material into three primary areas of interest? We did this not because they are mutually exclusive, but to emphasize their interrelation and their dependence on each other. Because the audience of a publication must be clearly in view before an effective editorial and advertising policy can be planned, we want to define the reader interests of TRAFFIC SAFETY as we see them, and as you see them on the cover:

Traffic Operations—police, engineers, judges and prosecutors, administrators and other representatives of government who have primary responsibility to initiate and carry out the official regulation of drivers and driving.

Public Support—safety councils, professional, business and service organizations, off-the-job programs of business concerns, women's groups and many others providing citizen support for official action.

Motor Transportation—for-hire and private trucking, buses, taxi and transit, and other commercial operators who not only have an economic motivation for traffic safety, but an obligation to seek it as good citizens and as co-users of the highway.

At first glance these audiences may seem to have little in common. But a more thoughtful view will discover that they have the one most important thing in common—the efficient movement of motor vehicles with the prevention of traffic death, injury and property damage. Each of these areas of interest must understand the problems and objectives and methods of the other. Each must strive for the solution of a common problem, because none can hope for complete success alone.

We hope to make this clear in TRAFFIC SAFETY, and to make our content useful to that end. We see this as a team effort, as a three-pronged approach to traffic safety, and we sincerely feel that a magazine which honestly serves this purpose will perform a useful function as a traffic safety magazine in the truest sense of the word.

Now let us tell you something about our editorial policy. We are very much aware that a publication can't claim the loyalty of readers on high purpose alone. We must present an editorial bill of fare which not only is nourishing, but savory in the eating. We hope to deserve your attention by entering more actively and vigorously into the traffic safety issues of the day. Consistent with objectivity and editorial responsibility, we will invite controversy and present challenging viewpoints.

You may not agree with us all of the time, or with the opinions of others presented in our pages, but we will try never to be dull. We want to search out and present facts on both sides of unresolved questions, thus carrying out the American tradition of letting open debate reveal the truth of public issues. Stated simply, we will endeavor not only to report history, but to take part in it.

When all is said and done, you are the boss. You who read (or don't read) TRAFFIC SAFETY will determine its success or failure. We invite your interest in making this magazine *your* magazine. We want to know what you like or don't like. Tell us how we can be more helpful. We have made a bold break with the past in this issue. Why don't you take a minute to tell us what you think of it and our plans? It will help us—and eventually, you. We'd like to hear from you, boss!

THE EDITORS

WHAT DID THIS MAN PROVE?

THE RELIABILITY OF BREATH TESTS

says Dr. Herman A. Heise, noted expert on tests for intoxication

HOW IT ALL STARTED —

William C. Rose, 44, a 238-pound apartment house manager, was arrested last Dec. 15 in Miami, Fla., for drunk driving. Police said he was driving erratically. A breath test showed a .246 blood alcohol percentage.

In court on Jan. 23, City Judge Francis A. Sobieski permitted Rose to challenge publicly the reliability of chemical test evidence. With newspapermen, photographers and newsreels present, he drank 20 ounces of 86-proof whiskey in five hours. During this time he played cards and ate lunch. He told newsmen he was "having a ball."

Judge Sobieski called a halt after the 20th drink. At that time his blood alcohol reading was .122 per cent. Police said he failed reaction and vision tests, his speech slurred, and he had difficulty picking up his cards.

The case received nationwide attention in the press. One newspaper stated: "Authorities hold that a reading of .15 on the widely used device indicates the subject is intoxicated. They assert that this state of inebriation normally will be reached after the consumption of six ounces of whiskey or six bottles of beer." Another newspaper headlined: "Beats Drunkometer." Because of the publicity and the misleading impression it gave of blood alcohol tests, TRAFFIC SAFETY presents the comments of Dr. Heise.—Editor.

No one is penalized for the amount of alcohol he drinks. It is the alcohol that he fails to burn or eliminate and which then circulates through his brain that causes trouble. It is this unburned alcohol that appears in the test—not what he drank.

A man spacing his drinks at the same rate he is getting rid of the alcohol can consume 12 ounces of pure 200-proof alcohol in 24 hours without showing any evidence of intoxication. With 86-proof liquor, he could drink about 28 ounces.

This shows the fallacy of the belief that drinking a certain amount will produce a definite degree of intoxication. What the newspaper reporters failed to point out is that a *150-pound* person must *accumulate* three ounces of alcohol in order to reach .15 per cent in the blood. Since he is burning some of his alcohol while he is drinking, he must drink more than the three ounces of alcohol contained in six ounces of 100-proof liquor or six 12-ounce bottles of 3.2 beer.

Also, a husky 238-pounder would have to accumulate more alcohol than a 150-pound man in order to have the same per cent. And don't forget that the eating of lunch slowed the absorption.

So let's see what William Rose's experimental tippling really proved. He drank 20 one-ounce shots of 86-proof (43 per cent by volume) alcohol in five hours. The actual amount of pure alcohol consumed was 8.6 ounces. He burned and eliminated some of this at the rate of almost one ounce per hour, which is about twice as fast as a normal individual of his weight.

This tolerance in no way affects the chemical test for alcohol, because he must drink twice as much to be drunk as a person of normal tolerance. This double amount consumed will not show in the test. He is being penalized not for his ability to consume alcohol, but for harboring sufficient *accumulated* alcohol to dull his senses *in spite of* his tolerance.

So instead of discrediting the chemical test, the experiment actually confirms the importance of the test. If 20 drinks produced some symptoms of intoxication and an alcohol reading of .122, it doesn't take an expert to realize how much more intoxicated he had been when he was arrested with a reading of .246—about twice as much.

A proper legal definition of "under the influence" can be stated this way: Due to the drinking of alcohol a person loses some of the clearness of intellect and self-control he would otherwise possess. With this definition it is unnecessary to prove that the person staggered or was dead drunk.

Carefully conducted experiments involving judgment and hand-eye coordination—qualities necessary to safe driving—show some deterioration in all individuals when the blood alcohol reaches .04 per cent. The effects become greater as the alcohol increases. When an auto driver has a test of .15 per cent, the chance of his having an accident is increased by about 5,000 per cent.

When committees of the American

Medical Association and the National Safety Council interpreted the percentages of alcohol for the legal confirmation of "under the influence," they realized that no fine dividing line could be drawn between sobriety and intoxication. Therefore, with extreme generosity they prescribed a range from .05, below which a moderately inebriated person could escape punishment, and .15 above which the evidence of intoxication is so definite that it could be given prima facie status. In the middle zone a person, despite his loss of judgment and coordination might still give a good enough impression to examining officers to warrant dismissal of the charge. However, it must be emphasized that a person is not drunk at .15 per cent and sober at .14 per cent—or necessarily sober at .05 per cent.

Chemical tests are important because there are at least a hundred ailments with symptoms resembling those of alcoholic intoxication. Even the odor of alcohol on the breath is open to question, because the characteristic odors are not due to alcohol but to the flavors of the drinks. Pure alcohol cannot be detected on the breath. So the chemical test exonerates the moderate drinker or the ill person, and it explodes the alibis of the actually drunk who claims his observed abnormalities are due to disease or injury.

When chemical tests are used in special studies to determine the role of alcohol in fatal accidents, as many as 50 per cent are in the "had been drinking" class. Of course, it is impossible to state that alcohol was solely responsible for the accidents studied, but when in one year 40,000 people are killed on the highways and more than a million seriously injured, we must combat a major factor in these accidents—alcohol. A chemical test program is a strong deterrent to drinking and driving.

HOW TO FIGURE UNBURNED ALCOHOL

Dr. R. N. Harger, pioneer in chemical tests and inventor of the Drunkometer, provides a formula for estimating unburned alcohol. A 150-pound person who burns alcohol at the average rate will destroy ⅓ fluid ounce of pure alcohol per hour, or ⅔ fluid ounce of 100-proof whiskey. Studies have shown that some persons can burn alcohol 50 per cent faster than the average, and a few at an even faster rate.

Assuming that William Rose's apparent tolerance resulted from a 50 per cent faster burning rate, he would oxidize or excrete 1 fluid ounce of 100-proof whiskey per hour (instead of the normal ⅔ fluid ounce). However, Rose weighed 238 pounds and he drank 86-proof whiskey. So in his five-hour drinking period he could destroy this amount: *hours* multiplied by *weight over average weight* multiplied by *100 proof over 86 proof*. The formula:

$$5 \times \frac{238}{150} \times \frac{100}{86} = \textbf{9.2 fl. oz. of 86-proof whiskey.}$$

He drank 20 ounces of 86-proof whiskey. Subtracting the burned amount shown by the above formula, he accumulated 10.8 ounces. Since 4 ounces of unburned 100-proof whiskey in a 150-pound man would give a blood alcohol concentration of approximately .1 per cent, Rose's calculated blood alcohol at the end of his demonstration should be:

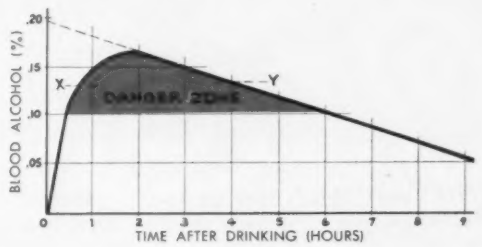
$$\frac{10.8}{4} \times \frac{150}{238} \times \frac{86}{100} \times .10 = \textbf{.15 per cent}$$

The apparent discrepancy between the calculated .15 and the actual test reading of .122 could be due to two factors. Rose burned alcohol more rapidly than the assumed 50 per cent faster rate, or the test was taken so soon after the 20th drink that the last ounce had not been absorbed into the blood. Calculated on 19 drinks, the formula shows .13—very close to the actual test result.

WHY A DRUNKEN DRIVER CAN'T JUDGE HIMSELF

Any person who has a given concentration of alcohol in his blood will be at some definite stage of intoxication. This is essentially correct, says Dr. C. W. Muehlberger, noted toxicologist and director of the Michigan Crime Detection Laboratory, but in the view of the drinker himself it will appear grossly in error.

Suppose a man drinks 8 ounces of whiskey. During absorption, when his blood alcohol reaches .13 per cent (X on the graph), he will feel much more intoxicated



than he will three hours later (Y on the graph) when his blood alcohol has fallen to .13. His performance at these two points will be almost equally poor. But—at **X** the drinker will be comparing himself to his previous state of sobriety, so he feels drunk. Three hours later he will be comparing himself with the immediate past of maximum drunkenness, and he will feel much more sober.

The graph also shows how much faster alcohol is absorbed than burned. For at least six hours after the start of drinking, this hypothetical tippler is a very dangerous driver.

HOW IT ALL ENDED

William C. Rose was fined $150 and his driver's license was suspended for one year.

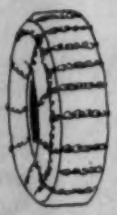
Judge Sobieski said in delivering sentence that Rose's courtroom quaffing "only bolstered my confidence in the Drunkometer."

14-INCH TIRES PASS SKID TEST

Deepfreeze laboratory reveals facts on new tires, chains, weight distribution – and lets the air out of an old wives' tale

14-inch Tires 4.5% Better

Mud-Snow Tires 32% Better



Reinforced Tire Chains 240% Better

More Weight on Rear Wheels Better

Lower Tire Pressure Worse

WHAT will 14-inch tires do besides put you a half inch closer to the road?

To find the answer, 43 men (and one woman) chose to stand around last January in six-below weather at Pine Lake, a frigid outpost near Clintonville, Wis.

The hot question on the cold front was how well the new, smaller tires would grip a road glazed with ice. A man who wants to drive to work in the morning even when it snows or freezes needs traction to get started, and once he gets started, he wants to be able to pick his own stopping place. When he turns his steering wheel, he would like the car to turn, too.

The 1957 winter tests were the first unbiased, industry-wide tests of the new 14-inch tires. The results are important not only to the safety of the winter driver, but also to the tire engineers who found the deepfreeze laboratory pointed the way to further design improvements.

Most of the "frozen 44" were members of the National Safety Council's Committee on Winter Driving Hazards, which has been studying the performance of cars, tires, tire chains and other winter traction aids since 1939. In the crowd watching a curling match in a lull between tests this year was the largest concentration of tire engineers ever assembled in the United States. The experts were joined by a dozen observers from newspapers, radio stations and industry.

What did they find out? Here is a summary of the results:

The 14-inch tire out-performed the 15-inch tire by an average of 4.5 per cent.

The mud-snow type tire out-performed the highway type by an average of 32 per cent.

The performance of highway tires was improved by an average of 240 per cent when equipped with reinforced tire chains.

Transferring a higher percentage of total weight to the rear wheels brought better performance. The improvement was greatest in the traction tests.

Reducing tire pressure below recommended pressure resulted in poorer performance.

To measure the traction of the 14-inch tires, the engineers hooked the test car to a truck with a cable and recording instruments. When this "train" began to roll, the car tried to pull away from the truck, and two observers recorded the force exerted on the cable. The traction readings dropped as the car wheels began to spin, again demonstrating the oft-proved point that wheel spinning is the worst way to get moving on snow or ice.

The braking tests were run at 20 mph on a strip of glare ice 1,000 feet long. At the instant the wheels locked, a test wheel behind the car started

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Test Talk

U. S. supreme court upholds blood tests

A decision of the New Mexico Supreme Court in the case of Breithaupt vs. Abram was affirmed by the United States Supreme Court on February 25, 1957. Breithaupt was the driver of a pickup truck which collided with another vehicle and killed three persons who were riding in it.

Breithaupt was taken to the hospital following the accident and there, while he was *unconscious*, a blood sample of about 20 cc. was withdrawn by the doctor on duty at the direction of a state patrolman. The blood sample was found to contain .17 per cent alcohol. He was convicted of involuntary manslaughter and sentenced to a prison term in the New Mexico state penitentiary. No appeal was taken following the conviction.

Breithaupt brought a habeas corpus action against the warden of the penitentiary charging that he was deprived of his constitutional rights because the evidence employed against him was obtained by unlawful search and seizure, a denial of due process.

The U. S. Supreme Court was appealed to on these same points, and in a majority opinion (six affirming and three dissenting) the conviction of Breithaupt was affirmed.

Drunk, influenced or intoxicated?

The terms "drunk," "intoxicated" or "under the influence" are often used loosely as though they were interchangeable, thus leading to considerable confusion. Any person who manifests any toxic action of alcohol is intoxicated. Carefully controlled psychological tests have shown that as little as one ounce of liquor will produce some measurable deterioration of performance even though such persons are, to the casual observer, entirely sober. Yet, because they do manifest evidence of the toxic action of alcohol, some would say that such people are intoxicated. If intoxicated and drunk are synonymous, then such persons are drunk. This is a rather extreme view.

On the other hand, there are some who believe that as long as a man can stand up to the bar he is not drunk. Between these two extremes there may be all shades of opinion.

The term "under the influence of intoxicating liquor," which appears in so many statutes which control the operation of motion vehicles, has been defined in court opinions as follows: "If the ability of the driver of an automobile has been lessened in the slightest degree by the use of intoxicating liquors, then the driver is deemed to be under the influence of intoxicating liquor. The mere fact that a driver has taken a drink does not place him under the ban of the statute unless such drink has some influence upon him, lessening in some degree his ability to handle his automobile." A person may be said to be drunk when, as a result of drinking an alcoholic

beverage, he becomes unfitted for the task he is attempting to perform. A person might be drunk or under the influence for one kind of job but quite sober for another.

The task of driving an automobile requires that all of the driver's capabilities be up to par. It is known that impairment of judgment is the first of the faculties to be affected by alcohol, making the use of chemical tests the only reliable proof that the driver was or was not "under the influence" and that his capabilities were affected to any degree.

Swiss use breathalyzer

Since July, 1956, the Traffic Bureau of Geneva, Switzerland, has been using the American made breath testing device known as the "Breathalyzer." Geneva is the first European city to use the Breathalyzer, a semi-automatic apparatus for the analysis of alcohol in the breath based on the constant correlation between the amount of alcohol in the blood and that in the breath. Thorough research has been able to establish that 2,100 cc. of alveolar air at 33 degrees centigrade contains as much alcohol as 1 cc. of blood. If the amount of alcohol contained in the breath is known, a simple calculation permits obtaining the amount in the blood.

By an ingenuous use of a photoelectric cell which moves a needle across a dial, directly graduated in blood alcohol, a simple reading gives the results of the test in less than five minutes.

Prof. Denys Monnier of the University of Geneva made a number of tests on volunteers to compare the results of the Breathalyzer with those of laboratory methods of analysis before turning the apparatus over to the Geneva police.

The Breathalyzer, now in use by a number of American cities, was developed by Capt. R. F. Borkenstein, chief technician of the Indiana state police laboratory.

26 States map chemical test legislation

Twenty-six state-legislatures have chemical test legislation in the hopper according to the American Association of Motor Vehicle Administrators. Eight states have bills introduced that would, if passed, enact the basic provisions of Sec. 11-902 of the Uniform Vehicle Code. Nine states are considering laws containing the code provisions plus the "implied consent" features (whereby a driver who refuses to submit to test when suspected of driving under the influence would have his license suspended or revoked). Nine others have pending legislation that would enact the implied consent provisions in addition to existing legislation modeled after the code.

TESTS FOR INTOXICATION COMMITTEE: *Chairman,* Dean Mason Ladd, Iowa Law School; *Subcommittee Chairmen,* Dr. C. W. Muehlberger, Michigan Department of Health, *research*; Dr. David G. Monroe, Department of Political Science, University of North Carolina, *legal matters*; Gerald O'Connell, Director of Training, Northwestern University Traffic Institute, *training.*

WHAT HAPPENED IN OCTOBER?

Daylight saving time fails to explain the big dip that reversed the death trend

LAST October traffic deaths dropped 12 per cent without apparent reason, reversing with surprising abruptness and magnitude a trend that had been steadily upward for 19 months. Mileage went up for the month. Neither weather nor preventive activity provided a satisfactory explanation for the change.

In searching for at least a contributing cause, the Statistical Divison of the National Safety Council explored the daylight saving time factor because some areas, especially large cities, extended fast time through October. The added daylight during city rush hours was considered a logical reason for some of the decrease, although not a probable one for a reduction as large as 12 per cent.

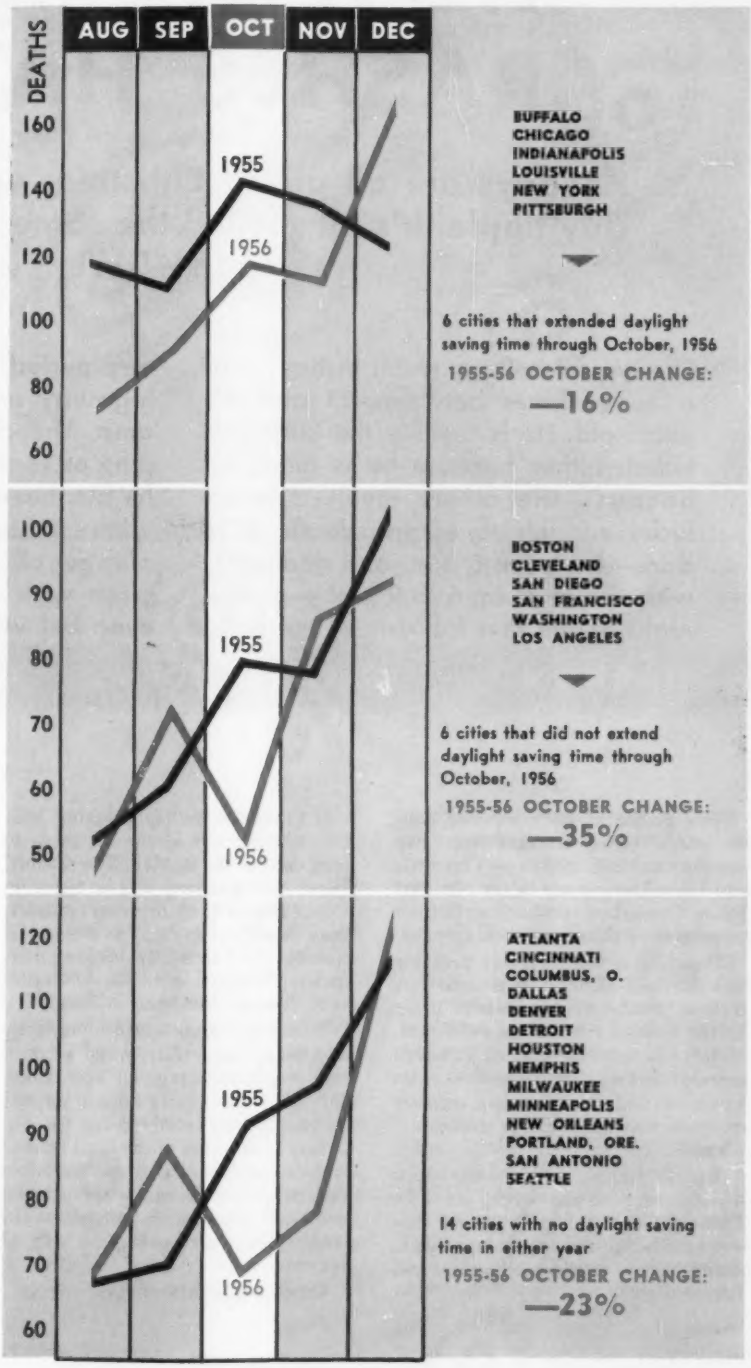
Of the 32 cities in the top four size groups (350,000 population and up), information was obtained on the status of daylight saving time in 26:

- **6 cities had daylight saving time in both 1955 and 1956, and extended daylight time in 1956 to include October.**
- **6 cities had daylight time in both 1955 and 1956, but did not extend it through October.**
- **14 cities did not have daylight time in either 1955 or 1956.**

The accompanying chart shows the traffic death record for each of these three groups during the final months of both years. The cities that extended fast time (top chart) actually had a smaller reduction in October as compared with the same month of 1955 than the other two groups which made no change. In fact, the 16 per cent decline in the fast time cities was even smaller than the 19 per cent average October reduction for all cities of the nation.

National Safety Council statisticians point out that the figures do not justify a conclusion that the extension of daylight time was harmful, but obviously it was not helpful. Certainly the extension had no effect on the astonishing October reduction.

(TRAFFIC SAFETY invites comments from city and state authorities on their October experience last year and any reasons they can advance for improvement.—Editor)



HOW HOLIDAY CRASHES HAPPEN

Holidays are all alike. Christmas eggnog or Labor Day tipple, it's all spelled the same on the accident report—DWI

The typical holiday traffic victim . . . is a male driver between 25 and 44 years old. He is usually the only one killed, either because he is alone or because the others involved were lucky enough to escape death. It is dark—between 6 p.m. and midnight, with the odds on 6 to 9 p.m.—on the night of the first full day of the holiday period. He is driving on a rural highway or in an unincorporated area. The chances are there are taverns or road houses nearby, because he has been drinking. He is speeding when it happens—an out-of-control plunge off the road, or a rending crash with another car. It's about an even bet which type it will be.

This profile of the composite holiday traffic victim emerges from two holiday accident studies — Christmas and Labor Day—made by the National Safety Council of special reports from state motor vehicle statistics agencies.

This is also the man who probably was the chief victim of Memorial Day crashes. Police will again have to be on the lookout for him on the Fourth of July—because the Council's analysis revealed this startling fact: *there is no significant difference between accident experience on a summer or winter holiday!*

Bottle-happy and throttle-happy drivers were at the wheel on both Christmas and Labor Day, and they were the big reason for the upsurge in death that has turned our holidays into horror days.

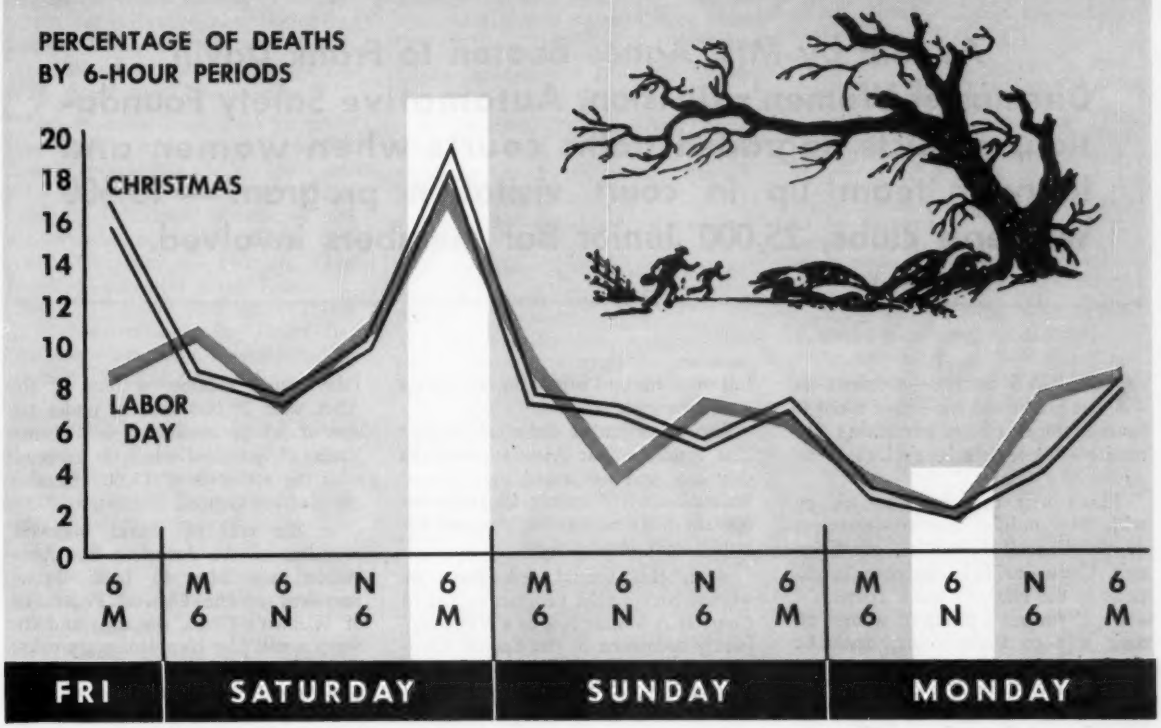
Is Christmas the big drinking holiday, when a nip in the air leads to more nips at the bottle? The Council found that drinking was a factor in 55 per cent of the Christmas fatalities, more than twice as many as the annual average. On Labor Day drinking drivers were involved in 48 per cent, again more than twice as many as normal!

Would you think speed more likely on a sunny Labor Day, when an open road would encourage an open throttle? Then the figures hold a surprise for you, because speed too fast for conditions or in excess of the limit entered into 71 per cent of the cases on Labor Day, while on Christmas speed violations took place in 85 per cent of the fatals! The annual average is only 37 per cent.

Other highlights of the survey:

- Accidents were most frequent early in the weekend—55 to 58 per cent in the first 30 hours of the 78-hour period.
- Accidents were most frequent between 6 and 9 p.m. The safest period was noon to 3 p.m. on Christmas, 6 to 9 a.m. on Labor Day.
- Non-collision accidents were most frequent on Labor Day, with 37 per cent to 33 per cent for multi-vehicle collisions. On Christmas the types were reversed, 33 per cent to 28 per cent.
- A rural area was the scene of 82 per cent of the Labor Day accidents, 72 per cent of those on Christmas.
- Single driver accidents accounted for 85 per cent of the Labor Day toll and 90 per cent on Christmas.
- Victims were usually the drivers.

SUMMER OR WINTER—THE PATTERN IS THE SAME



Both of the holidays studied by the Council—Christmas, 1955, and Labor Day, 1956—were 78-hour periods beginning at 6 p.m. Friday and ending at midnight Monday. The deaths were "immediates" only — those who died within the actual holiday period. The Christmas toll was 609, about 50 per cent higher than on other December weekends. The Labor Day count was 435, about 20 per cent over the normal September weekend of identical days, which made it one of the safest in recent years. In 1955, Labor Day was more than 25 per cent higher than a normal weekend, and in other years the increase has run well over 33 per cent.

The studies are of value to enforcement authorities in recognizing the similarity between holidays, especially the tremendous increase in drinking and speed, and in mapping their counterattack against the most publicized of all traffic safety problems. The figures, modified by information on local experience, permit a no-guesswork approach to selective enforcment during holidays.

The facts, for example, explode the fallacy that the really dangerous period for a holiday traveler is the race against time to get home again. Getting there is revealed as a far more hazardous undertaking than getting back.

Those who walked themselves to death, like those who drove themselves to death, also did it early. Seven out of 10 pedestrian deaths occurred in the first 30 hours of both weekends. Here again the expectation that yuletide tippling would boost the Christmas pedestrian toll higher than on Labor Day is not borne out by the reports.

So from almost every angle, the holiday traffic accident picture looks the same, summer or winter. Whether we consider speed, drinking, time, type of accident, location, age of victim, or any other facet of the holiday accident problem, every holiday looks mournfully like any other holiday.

Would you like to have the complete reports which are summarized in this article? Single copies will be mailed free on request to TRAFFIC SAFETY Holiday Study, National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill. A nominal fee will be quoted on requests for quantities.

LADIES DAY IN TRAFFIC COURT

As told by Mrs. Agnes Beaton to Frank Davin
Director of Women's Division, Automotive Safety Foundation, predicts upgraded traffic courts when women and lawyers team up in court visitation program — 15,600 women's clubs, 25,000 Junior Bar members involved.

AMERICA'S lawyers—members of the bench and bar—have taken to heart a slogan of the advertising fraternity—"Never underestimate the power of a woman!"

That's why they have teamed up with 5½ million women—members of the General Federation of Women's Clubs—to help improve conditions in the Nation's traffic courts.

So, if you see a group of women on their way to traffic court, don't be alarmed. They will be there as visitors, not violators.

The program began on May 13th. The General Federation of Women's Clubs—the world's largest organization of women, launched their drive to help improve conditions in America's traffic courts.

They aren't in court merely to judge the conduct of the jurist or to act as a jury in matters of law. In a larger sense, they will judge the community's role in the administration of justice since the purpose of the project is to see that the 5 million Americans who face the judge in traffic court each year meet with conditions of justice and dignity that will build respect for the law, particularly for our traffic laws.

Today, the majority of Americans come in contact with the administration of justice in the traffic court. So it is important that these courts be well-administered, honest and dignified.

In far too many communities, no effort has been made to modernize the traffic courts. Inadequate facilities and personnel are due mainly to the inertia and disinterest of local citizens. The lack of respect for traffic law is a contributing factor to the mounting toll of death and injury on our streets and highways.

Can the women's clubs get results? The American Bar Association thinks they can, and has asked the General Federation of Women's Clubs to cooperate in its nationwide program for traffic court improvement.

With this special task force of women backing the program—"Go to Court as A Visitor Not as a Violator," jointly sponsored by the Special Committee on Traffic Court Program and the Junior Bar Conference of the American Bar Association, it is almost a cinch to achieve results.

Since 1942, the American Bar Association has carried on its own program to bring about reforms in our traffic courts. Now it has placed in the hands of its Junior Bar Conference (the young member section of the ABA with 25,000 lawyers under the age of 35 as members) a "Visitor-Violator" program which is to mesh with the activities of 15,600 member clubs of the General Federation.

In the eyes of David Maxwell, president of the American Bar Association, and Mrs. R. I. C. Prout, president of the General Federation of Women's Clubs, the men and the women will play complementary roles:

1. The Junior Bar Conference, as a professional group concerned with the problems of the law, can act as liaison between the laymen of the community, the legal profession and the traffic court.

2. The women's clubs of the General Federation have long experience in rallying community support. They

Planning for Ladies Day in Traffic Court. From left: Robert B. Keating, chairman Traffic Court Committee, Junior Bar Conference; James P. Economos, director of the ABA's Traffic Court Program, and Mrs. Carol A. Taylor, headquarters secretary, Junior Bar Conference, listen as W. C. Farrar (right) maps program at Bar Center.

can organize effective action at the local, state and national levels.

The theme of the "Visitor-Violator" program is: "To go to court as a visitor—not as a violator." It is a program in which citizens of a community are invited to view the operation of the local traffic courts, with each visitor being asked to judge the court, its personnel and procedure.

Details of this giant court visitation program have been in the works for many months. Mrs. B. V. Todd, national safety chairman of the GFWC; James P. Economos, director of the Bar Associations Traffic Court Program; William C. Farrar, (Los Angeles) president, and Robert E. Keating (Denver), chairman, Traffic Court Committee of the Junior Bar Conference have been busy developing program aids and coordinating activities.

The visitors will review a dozen key items on their check lists to determine whether the traffic courts in their communities meet the minimum standards of effective judicial administration.

These check lists, prepared by the American Bar Association, are as follows:

1. Name: Is the word "Police" included in the name of the court? Yes ☐ No ☐

The use of "police" in the title is misleading and it is recommended by the President's Highway Safety Conference that steps be taken to substitute a more appropriate name such as "municipal" or "City," etc.

2. Court Room: Is the physical appearance of the court room dignified and impressive? Yes ☐ No ☐

Before answering check and consider the following: ☐ American flag displayed; ☐ Is the judge's bench elevated; ☐ Rail separates public from court part; ☐ Good acoustics; ☐ Well ventilated; ☐ Soundproof from outside noises; ☐Kept clean and orderly; ☐Suitable accommodations for clerk, bailiff, etc.; ☐ Does the judge have a private chamber; and ☐ Is the clerk's office separated from the courtroom?

3. Location: Is the traffic court located in the same building with other courts in your city? Yes ☐ No ☐

Preferably, the court should not be located in the police station.

4. Opening: Is traffic court opened with a formal ceremony? Yes ☐ No ☐

A formal ceremony serves many purposes such as reminding everyone that the court is an important part of government.

5. Separation: Are traffic cases tried separate and apart from all other offenses? Yes ☐ No ☐

It is recommended by the American Bar Association that special emphasis be given to traffic violations and that they be tried apart from ordinary criminal cases.

6. Traffic Ticket: Is the Uniform Traffic Ticket recommended by the American Bar Association and the President's Highway Safety Conference used in your city? Yes ☐ No ☐

The ticket (sample on reverse side of check list) sets out the degree of seriousness of six principal violations and dangerous conditions which contribute to the seriousness of the violation.

7. Prosecutor: Was a prosecuting attorney regularly assigned and present in traffic court? Yes ☐ No ☐

A prosecutor not only presents the evidence in an orderly manner but can assist the public in understanding court procedure.

8. Oath: Was the oath administered to defendants, witnesses, and police officers clearly, slowly and impressively? Yes ☐ No ☐

The manner in which the oath is administered is important in securing respect for the proceedings in the court room.

9. Defendants: Are defendants advised of their rights in court? Yes ☐ No ☐

Judges should explain that every defendant has the right to counsel, to a continuance to prepare for trial, to testify or not to testify, to cross-examine witnesses and to subpoena witnesses for his defense.

10. Judge: Does the judge attempt to correct violators by making appropriate remarks about traffic safety and necessity for voluntary traffic law observance? Yes ☐ No ☐

It is the court's duty to educate while it adjudicates. Participation in judicial conferences for traffic court judges and prosecutors at leading law schools assists judges in this task.

11. Fines: In your opinion are the fines assessed consistent and certain? Yes ☐ No ☐

Disproportionate fines by the same judge without explanation tend to create disrespect for traffic law enforcement.

12. Public Support: In your opinion, does the public approve of the activities of the traffic court? Yes ☐ No ☐

From May 13 through June 7, the General Federation of Women's Clubs program results will be reviewed with

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Talking it over in the Nation's capital. From left Robert J. Asman, Jr., D. of C. Traffic Court Committee, Junior Bar Conference; Mrs. Robert I. C. Prout, president, GFWC, and Judge Mildred Reeves, Washington, D. C., discuss campaign.

In Houston, Texas, Judge W. P. Kelly, senior traffic judge, meets with Mrs. M. H. Jacobs, president of the Houston Federation of Women's Clubs, and Sidney S. McClendon III, director of the Houston Junior Bar Conference group.

MUSHROOMING SAFETY COUNCIL GROWTH AUGURS SAFETY ERA

Expansion of Local Safety Group Activities Is Spurred by Urgency of Finding Solution to Traffic Accident Problem.

The recently organized Nassau-Suffolk County Safety Council, Garden City, Long Island, held its first Annual Safety Convention and Exhibition May 14.

Ned H. Dearborn, president of the National Safety Council, was the principal speaker.

The Council was organized under the auspices of the Long Island Association with Jack Bainbridge as managing director.

Thomas R. Goodfellow, president of the Long Island Railroad, is chairman of the board.

Pennsylvania Explains Speed

The Pennsylvania Governor's Traffic Safety Council points out to drivers of that Commonwealth a 150 pound human, driving a car at 60 mph, would have the impact of a 30 calibre machine gun bullet if it were to hit a fixed object.

This, and similar lay language information is contained in "Facts You Should Know About Speed, Impact and Your Driving," which the Council has published.

The four-page leaflet includes a table showing the chances of being killed when involved in accidents at various speeds, but makes the primary point that, while impact and not speed alone, causes deaths, "speed is a handy-dandy way to make sure you have enough impact."

Idaho Expansion

The Idaho Chapter, NSC, has undertaken a poll of its members to determine their attitude on a change in its by-laws which would permit the addition of a vice president for traffic and the addition of three standing committees: highway traffic, farm and home safety.

If the membership approves, the Chapter plans to expand into these areas. Its previous activities have been primarily in the industrial field.

Wisconsin MD's Study Traffic

The State Medical Society of Wisconsin has created a new Division of Safe Transportation to determine whether member physicians can help curb traffic accidents.

The doctors will attempt to provide answers to such questions as: Does imperfect health cause a significant number of traffic accidents? What can be done about such major causes as errors in judgment, speed, and alcoholism? Are tinted windshields dangerous, especially for older drivers?

The physicians' group is working in liaison with the Motor Vehicle Department.

There Were 563 Winners

Ten boys and girls won prizes—portable radios and theater coupon books in a bike safety poster contest conducted by the Tell City Tube plant of the General Electric Company, at Tell City, Indiana. The youthful entrants submitted 563 bike safety posters.

The contest was open to pupils in the elementary grades of the four Tell City grade schools.

Winners are: First row, from left: James Hartz, Judith Schaefer, Laura Lee, Diane Duggan, Rocky Winchell, David Clark. Second row: A. H. Oberhausen, manager, E&PCR, Bill Lautner, Jerry Gudorf, Jim Meek, Linda Gibson. Third row: W. M. Kron, plant manager; Glen Bretz, school superintendent; Sgt. Don Smiley, Indiana State Police, and Judge John A. Sabo, Indiana Office of Traffic Safety.

Brass Button News

Radar must be accurate

Virginia's Supreme Court of Appeals has made it plain that the state must prove the accuracy of its radar machines used in checking speed violators on the state's highways.

The Virginia high court reversed two convictions in March of this year, both involving the same motorist, because prosecutors had failed to bring out compliance with the prescribed tests of the equipment for accuracy.

Electronics authorities state that it is important to check the radar (or other speed measuring devices) after they are placed at a site and before their removal from the site.

The court said the state legislature (in Virginia) had made such speed indications admissible in evidence, but it also said the law "does not eliminate the necessity for the Commonwealth to prove that the machine or device used for measuring speed has been properly set up and recently tested for accuracy."

17 states have vehicle inspection

Seventeen states have periodic motor vehicle inspection laws (as of March 31, 1957). Fourteen of these states have active (official) motor vehicle inspection programs in operation, and three states have inspection laws but no inspection program operating. States with inspection laws and programs operating are: Colorado, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New Mexico, New York (cars four years old and older), Pennsylvania, Texas, Utah, Vermont, Virginia and West Virginia. States with laws but no official inspection program are: Maryland, Mississippi, and Washington.

South Dakota law requires the annual inspection of lights only. Six of the fourteen states require one inspection each year and eight of them require two inspections annually. The fees range from 50 cents annually to $1.50. Delaware includes the inspection fee in the annual motor vehicle registration fee. The District of Columbia has a periodic inspection law with an annual fee of $1.00.

Special cars curb hot rods

The "drag" season is with us again, but Ohio's state highway patrol is ready for it. Alarmed by the increasing number of "drag races" on the highways last year, the patrol initiated the use of specially marked cars, identified by inch-high lettering on the doors, their siren and flasher lights concealed. Uniformed patrolmen manned the cars.

A total of 502 arrests were made during the first six months of their operation in 1956, and 98 per cent of the arrests resulted in convictions. In the drag races, strategically located lookouts no longer were able to warn their

drag racing friends of approaching patrol cars. Col. George E. Mingle, patrol superintendent, reports that drag racing on the open highway has been curbed effectively. A decrease in fatalities on rural state highways during the last six months of 1956 was the result of this enforcement technique. The special cars are used for other enforcement problems—to prevent the unsafe practices of a few commercial drivers "who watch the rear view mirror for a patrolman and habitual violators who obey the law only when a patrolman is in sight."

Police pay balks recruiting

Shortages of policemen have aroused three cities to full-scale recruitment campaigns.

Radio, television, posters, display advertising on newspaper sports pages, news releases on the work of the police force, billboards, handbills and police-manned information booths were used by Philadelphia, New Orleans and San Francisco.

In spite of the effort, San Francisco fell more than 900 below its goal of 1,500 new policemen. New Orleans also failed to fill all vacancies.

The International Association of Chiefs of Police has stated its conviction that low salaries are the chief cause of shortages which exist all over the country.

Poll backs absolute speed

A statewide public opinion poll favored an absolute speed limit of 65 mph for passenger cars in Illinois, but disapproved a proposal to raise the legal maximum speed for trucks and buses.

The results of the poll were made public in April. Responses were received from 3,000 licensed drivers who are business and professional men, office workers, students, tradesmen and housewives.

A heavy majority, 82 per cent, favored an absolute speed limit on the open road in place of the present rule permitting anything "reasonable and proper." A majority of 70 per cent named 65 mph for day time, and 55 for night time as their preference. There were 26 per cent who favored a lower maximum speed, while 15 per cent were against any set maximum. The remaining 4 per cent voted for a higher ceiling on open road speeds or indicated no preference.

The poll indicated that 78 per cent favored a 45 mph limit for all heavy trucks and that 72 per cent favored a 45 maximum for buses.

The citizens poll also favored periodic mechanical inspection of all motor vehicles and financial aid for high school driver education. The vote was 65 per cent for compulsory mechanical inspection and 66 per cent for high school driver education, with a nearly even division on whether the money should be raised through higher driver license fees or higher fines for traffic violations.

PUBLIC RELATIONS

PRO DRIVERS' SAFE OPERATION RATES PRAISE

Safe performance of Albany, N. Y. taxi fleet rates editorial in *Times-Union*

THE safety performance of commercial vehicle fleets and professional drivers is increasingly in the news these days and occasionally even merits mention on the editorial pages of newspapers. Here is a recent editorial, "Safety Payoff," from the Albany (N. Y.) *Times Union*:

"From time to time, the *Times-Union* has extended words of commendation to business concerns for activities in the public interest.

"Another such firm is the Pine Hills Taxi, Inc., of Albany, which has instituted such a successful safety program that its record nine years ago of more than 350 accidents in transporting 800,000 passengers a million and a half miles has been bettered to the extent that only 62 accidents (mostly minor) occurred to company vehicles in the past year, although a million passengers were transported two million miles.

"This is the result of an educational safety program inaugurated in 1950, with a schedule of weekly messages and hourly safety announcements via two-way radio to the firm's drivers. Safety meetings are held monthly in the company's headquarters.

"How this program has paid off was illustrated the other night when all the drivers were guests at a dinner attended by state and city officials. Those drivers who qualified under rules of the National Safety Council were awarded certificates and pins of the national organization, plus monetary awards. This has become an annual event and is an integral part of the firm's program.

"An added feeling of pride was transmitted to the drivers by the words of Police Chief Tuffey of Albany who praised the typical taxi driver as a good, substantial citizen and extended his thanks for drivers' cooperation with the police which has resulted in several important arrests.

"When those men returned to their cabs that night, there was one important word engraved in their minds—SAFETY! And it apparently stays there throughout the year."

Passengers Snub Safety Devices

City bus passengers don't make full use of the safety features provided in a transit vehicle, said M. G. Bullock, supervising engineer, Transit Casualty Company, in discussing "On-Board Accidents" at the regional meeting of

To Page 27

National Safety Council Safe Driver Award number 900,000 was presented to C. V. Twining, a driver for the Des Moines, Iowa, fire department last month at an award banquet sponsored by the Des Moines Association of Insurance Agents.

Twining, left, is receiving his award from Des Moines Mayor Ray C. Mills. Other officials present are (from left) George Forster, Des Moines city manager; Frank McGowan, city council member; Albert Diel, chairman of the safety committee, and Wayne A. Mackaman, president of the agents' association.

In addition to Twining, 322 other city employees received National Safety Council Safe Driver Awards.

ARE POLICE SAFE DRIVERS?

By George A. Otlewis,
Chief, Chicago Park District Police, and
President, International Association of Chiefs of Police

Not the safe drivers they ought to be, says Chief Otlewis. They have accidents in the same way other drivers do. Pursuit accidents account for one-third of the police accidents, routine patrol work for the balance.

WHEN you ask a police executive the question, "Are police safe drivers?" you have to expect a prejudiced answer. But the facts reveal that police are not the safe drivers they ought to be.

These same facts also show that, given proper supervision and incentive, police rate right up there with the best professional drivers.

The records come from the Police Division of the National Fleet Safety Contest, co-sponsored by the International Association of Chiefs of Police and the National Safety Council. So our facts are those reported by police departments themselves.

And they explode two other commonly accepted fallacies:

> First, they debunk the misleading belief that police are automatically safe drivers by association with enforcement of traffic laws. Second, they definitely correct the false notion that use of motor vehicles in law enforcement is, by its very nature, often hazardous and conducive to accidents.

Too many patrol drivers, police supervisors and law enforcement officials accept these fallacies as truth. The record shows, however, that police drivers have accidents in the same way that other drivers do in their day to day driving. Although the records of many police departments are good, many fail to meet the mark set by a substantial number of commercial fleets.

Unfortunately, their association with law enforcement activity does not automatically make policemen good drivers. All too often there is a tendency on their part to drive as if the emergency right of way granted for pursuit work extends to all police vehicle operation. Failure to observe traffic signs and signals or to follow the pace of general vehicular movement while engaged in routine patrol work is noted on too many police accident reports.

Studies show that pursuit accidents actually account for less than one-third of those charged against police fleets. The other two-thirds result from routine patrol duty.

Even with no reduction in pursuit accidents, police fleets still have a big area for improvement if they will concentrate on routine patrol accidents.

Accident experience reported in the Police Division of the National Fleet Safety Contest during the past few years indicates that police fleets are not as safe as we would like them to be. During the contest which ended June 30, 1956, 43 per cent, or more than 5,400 of the 12,000 police vehicles enrolled were involved in a reportable accident. Prior years show a figure of 38 per cent.

Compared with the incidence of involvement of other contestants, the police rate is not good. Commercial truck, bus, taxicab and sales care averaged 33 per cent during the same period.

State patrol drivers, as might be expected, averaged fewer accidents than municipal police. State police averaged 200,000 miles between accidents. The average for municipal police was 33,000 miles.

Despite the low accident rate of state police, they came in second best to professional passenger car drivers operating west of the Mississippi River. These passenger car drivers averaged an amazing 227,272 miles between accidents.

Patrol drivers are always "on parade" as far as the public is concerned. This is especially true when they operate conspicuously marked vehicles. In addition to our natural desire to have a good safety record we must set an example for the motoring public. Police driving errors are greatly magnified and collisions are indelibly recorded in the minds of the public. They will be quick to forget—in fact, most people will be sympathetic to—a patrol driver involved in a pursuit accident. But let a squad on routine patrol hit a parked car, go through a stop sign and hit another vehicle or fail to signal a left turn and be sideswiped, and witnesses will talk about it for a long time.

If police fleets are not as safe as

Nine Fleets Were Safest

Winners in the National Fleet Safety Contest Police Division, sponsored by the International Association of Police Chiefs, were honored at the IACP Convention held in Chicago last September.

they should be, how do they go about improving their record? First, they must report and record all accidents involving police vehicles. Second, they should figure their accident frequency rate in a manner prescribed by the National Fleet Safety Contest and used by the majority of fleets throughout the country.

Police departments not presently participating in the Police Division should enroll at the next registration.

Participation in the National Fleet Safety Contest will do more than keep a department informed of its standing, it will stimulate safe police car operations. Such competition uses prime human motivation factors, and seldom fails to bring about an improvement in accident experience. Many reports of better driving performance have come to our attention recently. A few of these are included to show you it can be done.

The Oak Ridge, Tennessee, Police Department averaged 13 accidents a year in the four years prior to entry in the contest. During the three years they have competed in the contest they have averaged seven. In 1949, for example, the department had 28 accidents. In the 1955-56 contest year they only had one.

Chief C. T. Vettel of Oak Ridge says: "Even if the ultimate goal of a 'no police traffic accident year' is reached by our department, redoubled efforts toward safer driving habits for our police drivers would still be our order of the day."

Colonel C. J. Sanders, superintendent of the Nebraska Safety Patrol, is another contest booster, and here's his reason: "The overall effect of contest participation can best be measured in the following terms," he said, "during the 1953-1954 contest year, members of the Nebraska Safety Patrol traveled 4,376,046 miles and had 13 reportable accidents. The following year, nine accidents were recorded while traveling 5,467,868, and for the year ending June 30, 1956, only six accidents were recorded for the 5,817,362 miles traveled.

"During the three years of contest participation the number of patrol units increased from 130 to 160 while the accident rate dropped from .30 to .10 accidents per 100,000 miles of travel.

"We heartily endorse the principles and the operations of the Police Division of the National Fleet Safety Contest. Regardless of whether the Nebraska Safety Patrol wins top honors again, we believe that the program has helped us and other enforcement agencies to exemplify the type of behavior in traffic which more motorists should follow."

Chief J. A. Bennett of Riverside, California, puts it this way:

"Although we already had our own police vehicle safety program under way when the Police Division was inaugurated, our entry in the competition gave our program a much needed boost. Our operations have improved to the point where our accidents have been drastically reduced."

According to Chief Bernard J. Kennedy of Peoria, Illinois, who said:

"We feel that participation in the Police Division of the Fleet Safety Contest has helped to improve our departmental traffic safety record. The award we won in the 1955-56 contest has given our officers justifiable cause for pride in their accomplishments and has shown them, concretely, what can be done with a little effort."

Commissioner Bernard R. Caldwell of the California Highway Patrol is Chairman of the IACP Traffic Committee and is recognized as one of the foremost authorities in the country on police traffic supervision. His department has been in the contest from the start.

"At the end of the first year of the contest," said Commissioner Caldwell, "we showed a total of 200 accidents and a rate of .7303. A concentrated effort toward improvement was needed, and here's what we did:

"1. Cadet driver instruction was intensified.

"2. A request for an appropriation to construct a training road network on the Academy grounds to extend cadet and in-service driver instruction was made.

Turn Page

(It is expected that the current session of the Legislature will approve its construction.)

"3. Commanding officers were informed of the high accident rate and were requested to keep officers advised of the number of accidents and to discuss with them reasons for the accidents as well as a method of avoiding involvement.

"4. A Departmental Occupational Safety Committee was established.

"The program had its effect. The year ending June, 1955, showed a 10 per cent increase in miles operated, while accidents decreased to 76 dropping our rate to .24. Our efforts continued and for the year ending June, 1956, despite a further increase of approximately 20 per cent in miles operated, we were able to compile a record of only 41 reportable accidents with a rate of .10."

A reduction of accidents reported by these police organizations during the past three contest years has been most gratifying. They show, for one thing, that there are no losers in the Police Division of the National Fleet Safety Contest. Every department entered in the contest gains when, through participation, its members are made aware that police vehicle accidents can be prevented.

It should go without saying, that a reduction in accident frequency brings about a financial savings to the department. Who wouldn't welcome the opportunity to squeeze out a new squad car or more from money saved from reducing accidents? It would seem to be a lot easier than trying to increase budgets. A sure way to get money for the things that police departments need is to spend less for accidents which can be prevented.

Training police drivers in the safe operation of automotive equipment is as important as training officers in all other techniques of law enforcement. It is not only important from the standpoint of efficiency and economy, but it is also an absolute necessity when considered in the bright light of Police Public Relations.

We'll admit that Contests alone will not do the full job. Proven methods of Fleet Safety management practiced by top carriers throughout the country, consisting of driver selection, training and supervision, as well as proper vehicle selection and maintenance must be introduced and sustained. One of the easiest ways to get such a program under way is through use of the National Safety Council's Complete Motor Transportation Service.

During 1956, for example, more than 1,000 state patrol drivers in Texas, North Dakota, Wisconsin and Illinois earned the Council's coveted Safe Driver Award. Winning the *"highest award for professional safe driving performance"* is not easy, but, such recognition is proof positive that the men who wear it are safe drivers.

THE END

Dearborn Receives Award

The annual award of the Pennsylvania Association for Safety Education for meritorious service to safety has been conferred on Ned H. Dearborn, president of the National Safety Council.

Presentation of the award to Mr. Dearborn and four other recipients was made at a dinner in Mechanicsburg, Pa., April 5.

"The results and influence of Ned H. Dearborn's leadership upon the national accident prevention picture will endure for many, many years," said Dr. Arthur Weigle, of the University of Pittsburgh, in presenting the awards as chairman of the awards committee. "He has served with honor and distinction."

Other recipients of the award were Arthur T. Moore, of the Pittsburgh Sun Telegraph; Owen F. McConnell, of the Philadelphia Inquirer; James T. Hamiland, chairman of the safety committee of the American Automobile Association of Pennsylvania, and Joseph Intorre, retiring president of the Pennsylvania Association for Safety Education.

NUTI Chem Test Course

A five-day course in chemical tests for intoxication will begin June 24 at the Traffic Institute of Northwestern University, Evanston, Ill.

Tuition for the 35-hr. course is $55. Registration is limited.

Wagner-Sangamo TACHOGRAPHS lessen maintenance costs, improve operating performance, and encourage safer driving habits!

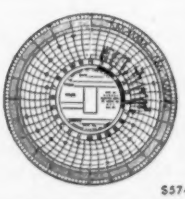
The trip information recorded on Tachograph charts will guide you in route planning, preventive maintenance, and driver training.

The Tachograph is a recording speedometer which records this information: when truck started; speeds and distance traveled; time and duration of stops; when engine idled. Illuminated dials show driver time of day, total mileage, and speed (or r.p.m.). A red light warns the driver when your pre-determined speed limit is exceeded.

For more information on how Tachographs can trim your operating costs and help your safety record, mail the coupon today.

Wagner Electric Corporation
6467 PLYMOUTH AVE., ST. LOUIS 14, MO.
Please send a copy of Bulletin SU-3.

Name and Position_____
Company_____
Address_____
City_____ State_____
We operate_____ (NUMBER) Vehicles



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PRO DRIVERS OPERATION PRAISED

From Page 21

the American Transit Association recently held in Toledo, Ohio.

Citing a study made of on-board accidents incurred on a large city transit property, Bullock emphasized the following points:

1. Most falls are caused by averted traffic accidents.
2. Over half were standing prior to their fall, and two-thirds were not holding to a support even though one was available in many instances.
3. Only 3 per cent used the overhead grab rod.
4. Most falls involved women.
5. Sixty per cent of falls involved persons over 50 years old.
6. "On-Board" accidents occur in all areas of the transit vehicle, but the area to the rear of the fare box produces the greatest number of claims, even though the greatest number of accidents is in the area extending from approximately six feet behind the operator to the center exit door.

Booklet for Fleets

The key to safer—and more profitable—motor vehicle fleet operations, according to a booklet just published by the Association of Casualty and Surety Companies, is a control program administered by fleet safety supervisors in which management cooperation and the effective control of drivers and equipment are the three vital elements.

Proper consideration for the selection, scheduling, routing and maintenance of equipment, and supervision of drivers will result in a smooth, well-knit operation and achievement of management's goals, ultimately expressed in profits, according to the booklet.

The booklet, titled "A Control Program for Motor Vehicle Fleets," is being distributed through the Association's home office and member companies.

Putting together a Congress program is a serious business, but it can be done with good humor, as witness this view of the Transit Section Executive Committee in action April 1 and 2 at a meeting in Toledo, Ohio. From left around table are J. Godfrey Butler, D. C. Transit Co.; M. E. Sternburgh, New York City Transit Authority; M. G. Bullock, Transit Casualty Co.; Joe V. Garvey, Harrisburg Railways, program chairman; D. L. Williamson, Cleveland Transit System, general chairman; Lee Mills, Cincinnati Transit Co.; R. D. Cassell, Safety Motor Transit Co., and Harry W. Whitcomb, Philadelphia Transportation Co. Standing (from left) Chris Imhoff, NSC staff, and E. A. Thiel, Columbus Transit Co.

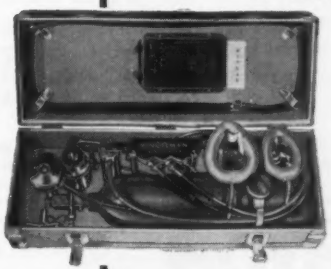
Graubard Firm Moves to New Address

Graubard's, long-time manufacturers of school safety patrol equipment, has moved to their new building at 236 High Street, Newark, N. J., approximately three times the size of their former quarters.

The move reflects the growth of the safety patrol equipment business since the company entered the field more than 20 years ago. They also manufacture costumes and school and band uniforms.

Back the Attack on TRAFFIC ACCIDENTS

For QUICK LIFESAVING SERVICES IN RESPIRATORY EMERGENCIES



STEPHENSON "MINUTEMAN" RESUSCITATOR

This lightweight, lifesaving device is especially designed for FAST application in cases of shock, heart attack, suffocation, drowning, etc.

Write for FREE demonstration or pamphlet S-406

STEPHENSON CORPORATION
RED BANK NEW JERSEY

Weighs only 30 pounds.

"Makers of the Harger Drunkometer and Breathalyzer for determination of intoxication by analysis of breath."

Ladies Day in Traffic Court

From Page 19

the Junior Bar Conference representatives in every city which participates. Where needed, a program to upgrade the traffic court will be undertaken.

Mrs. Todd has sent all state and district safety chairmen of the General Federation of Women's Clubs a booklet—"Better Traffic Courts—Key to Safety." It reviews specific steps for the women to take in working cooperatively with members of the Junior Bar Conference in local communities. Clubwomen are urged to rely on these lawyers' groups for guidance in approaching the traffic court problem in each state.

The General Federation member clubs have long played an effective part in promoting traffic safety on all fronts—engineering, enforcement and education.

The women have fought and won in many states and communities on issues of basic safety legislation, driver education for high schools, and engineering improvements. More than 5,000 member clubs recently signed a scroll for traffic safety, pledging to make this their *Number One project.*

At the national, state and local levels, Federated clubwomen have become an effective force for community traffic safety measures. When they *go to court* in the interest of justice, dignity and efficiency, the country may be amazed at the results. THE END

Chief MacDonald Dies

Thomas Harris MacDonald, 76, who had an important role in developing the nation's modern-day highway system died April 7th on the campus of Texas A & M college, College Station, Tex.

He served as chief of the United States Bureau of Public Roads for 34 years until his retirement in 1943. He then went to Texas A & M where he held the title of distinguished research engineer.

Chief MacDonald was also instrumental in developing the Annual Inventory of Traffic Safety Activities which the National Safety Council conducts as the yardstick of traffic safety progress for the Action Program of the President's Highway Safety Committee. In its 25th year, it was formerly the National Traffic Safety Contest.

Mr. MacDonald was a native of Leadville, Colo. He wrote a thesis at Iowa State College, Ames, in 1904 on the need for better roads for farmers. In 1907 he was named state highway engineer for the State of Iowa. MacDonald was called to Washington in 1919 at the age of 38 to take charge of the national highway program.

Warner, Inventor of Auto Speedometer, Dies

A. P. Warner, 87, inventor of the automobile speedometer, and auto headlight lens and electric brake and clutch, died in Beloit, Wis., on March 22.

Parents ~~WANT~~ *demand* a WELL EQUIPPED Safety Patrol . . .

That's where we can help . . .

Graubard's Equipment is nationally known as the school safety patrol equipment "That Promotes Safety." It does this by fulfilling both of the conditions essential to a really effective Safety Patrol.

First, it gives each patrol member a definite sense of responsibility and a pride in doing his job well.

Second, being "Standard Equipment" it is recognized by school children and motorists alike, assuring their respect and cooperation.

Take the time to check your safety patrol today! Look over the many "standard" Safety Patrol Equipment items listed below and be sure your patrol members are properly uniformed and ready to perform the vital task of protecting your children, in all kinds of weather! . . .

Belts	Emblems	Merit Awards	School Warning Signs
Caps, Helmets	Raincoats	Boots & Overshoes	
Badges	Capes	Corporal Digbys	Traffic Control Signs
Arm Brassards	Caution Flags	Trafficones	

GRAUBARD'S

Note New Address

236 High Street Newark 2, N. J.

"America's Largest Safety Patrol Outfitters"

OPERATION Safety

SAFETY POSTERS

"SHIFTING MENTAL GEARS" has become as important as driving skill in today's traffic pattern. Varied driving conditions brought about by the growth of the expressway, the increased use of the automobile for everyday needs as well as for extended vacation trips and the shifting patterns of residential and shopping areas call for a more alert, more flexible, more thoughtful driver.

Emphasis of the Operation Safety theme for August—"Share the Road" Driving—is on driver adaptability to changing traffic situations. Many of the items in the kit—news releases, editorial, speech outline, radio scripts and other aids—deal with techniques vital to help motorists use the new high-speed roads safely.

The August kit materials also reflect the stepped-up official action being taken through the nationwide BACK FOR ATTACK program to curb traffic accidents and provide for a smoother, safer flow of traffic. Official agencies, including police and courts, motor vehicle departments, highway departments and traffic engineering sections are leading the nation-wide "attack" on traffic accidents. In many states they are being aided by the passage of new traffic legislation.

Featured poster of the month shows an orderly traffic picture on a modern expressway with the slogan, "Keep in Step with Traffic—Share the Road." This poster continues an approach to improving driver and pedestrian attitudes begun earlier this year with the "Make Driving Pleasant—Follow the Rules" poster. These posters stress the positive or pleasurable side of driving.

The pedestrian poster is a humorous animation of an auto and pedestrian "squaring off" with boxing gloves in the center of the traffic "ring"—an intersection. The slogan says (to the pedestrian), "When You're Out of Your Class You Might Get Hurt!"

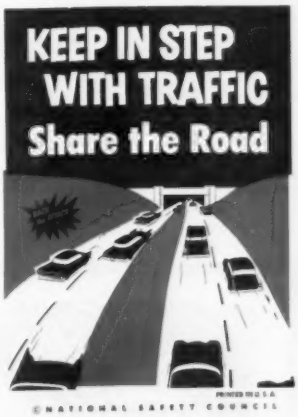
Leaflets sampled in the August kit include "Close Ranks," the third in the Back the Attack series—and "Alert Today—Alive Tomorrow."

Back the Attack on TRAFFIC ACCIDENTS

TO MOTORISTS **TO PEDESTRIANS**

FOR AUGUST SHOWING

IMPRINT DEADLINE JUNE 15th



T-1073-C **25x38**
T-1074-A **8½x11½**

T-1075-B **17x23**

ADVANCE SHOWING FOR SEPTEMBER POSTING

IMPRINT DEADLINE JULY 15th

T-1090-C **25x38**
T-1091-A **8½x11½**

T-1092-B **17x23**

PRICES FOR ABOVE POSTERS

Traffic Posters—T-prefix to number	1-5	10-99	100-999	1000-4999*
A Size	$0.15	$0.092	$0.063	$0.052
B Size	.25	.18	.15	.12
C Size	.35	.27	.22	.20

YOUR CREDIT LINE can be imprinted (at the time of the press run) on B and C posters only. A minimum of 45 days prior to the first day of the month of posting is required on all orders for imprinting.

*Write for prices on quantities of 5,000 or more or for special rates on annual poster orders.

SAFETY POSTERS

POSTER PRICES

Posters illustrated on these pages are included in the automatic Motor Transportation poster services. Automatic poster sets are available on yearly subscription that provides (4) subjects per month viz. (2) "A" size (8½"x11½") and (2) "B" size (17"x23"). Automatic service is provided in the following categories:

City Truck Intercity Truck Sales Truck Truck Terminal	City Bus Intercity Bus Taxicab Bus Terminal	Annual price 1-4 sets, $8.85 per set; 5-49 sets, $7.45 per set; 50 or more sets, $5.95 per set.

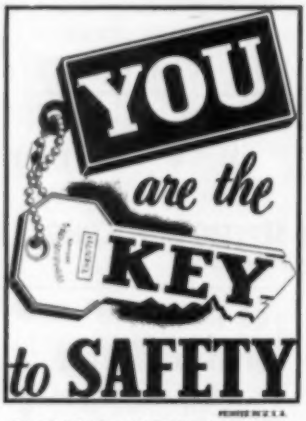
Posters are available for individual selection at the following prices:

	1-9	10-99	100-999	1000-4999*
A size, any selection	.15	.092	.043	.052
B size, any selection	.30	.22	.185	.15

All prices shown are subject to a 10% discount to National Safety Council Members.
*Write for prices on quantities of 5,000 or more.

©NATIONAL SAFETY COUNCIL

V-1071-A 8½x11½



©NATIONAL SAFETY COUNCIL

1041-B 17x23

NATIONAL SAFETY COUNCIL

0478-A 8½x11½

©NATIONAL SAFETY COUNCIL

1037-A 8½x11½

NATIONAL SAFETY COUNCIL

0089-A 8½x11½

NATIONAL SAFETY COUNCIL

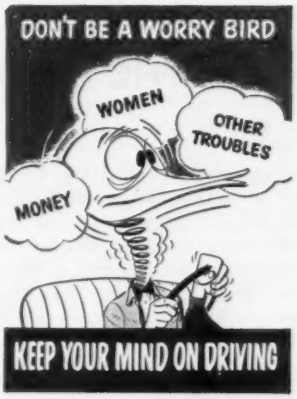
9347-A 8½x11½

NATIONAL SAFETY COUNCIL

8432-B 17x23

V-1070-A 8½x11½

V-1072-B 17x23



V-9765-A 8½x11½

V-0240-B 17x23

V-9413-B 17x23

V-0290-B 17x23

V-9516-B 17x23

V-0061-B 17x23

V-9819-B 17x23

THE TRAFFIC RECORD

From Page 7

were Norfolk, Va. (213,500); Bridgeport, Conn. (158,000), and Berkeley, Calif. (113,800).

The three leading cities in each population group at the end of March, ranked according to the number of deaths per 10,000 registered vehicles, were:

	Reg. Rate
Over 1,000,000 Population	
Chicago, Ill.	2.6
Detroit, Mich.	3.0
Philadelphia, Pa.	3.6
750,000—1,000,000 Poulation	
Baltimore, Md.	1.8
Washington, D. C.	2.9
Cleveland, Ohio	3.1
500,000—750,000 Population	
Seattle, Wash.	1.4
Boston, Mass.	1.8
Pittsburgh, Pa.	2.0
350,000—500,000 Population	
Denver, Colo.	0.9
Memphis, Tenn.	1.7
Indianapolis, Ind.	2.0
200,000—350,000 Population	
Norfolk, Va.	0.0
Syracuse, N. Y.	0.5
Wichita, Kan.	0.9
100,000—200,000 Population	
Bridgeport, Conn.	0.0
Montgomery, Ala.	0.0
Berkeley, Calif.	0.0
50,000—100,000 Population	
Lansing, Mich.	0.0
Madison, Wis.	0.0
Pontiac, Mich.	0.0
25,000—50,000 Population	
Muskegon, Mich.	0.0
Yakima, Wash.	0.0
Odessa, Tex.	0.0
10,000—25,000 Population	
Modesto, Calif.	0.0
Casper, Wyo.	0.0
St. Clair Shores, Mich.	0.0

New Kind of Safety Contest

The Annual Inventory of Traffic Safety Activities report for Glendale, California, brought to light some information this year on a unique safety contest between Glendale and its safety rival, Burbank.

It seems the two cities compete each December to see which city has the fewest traffic accidents.

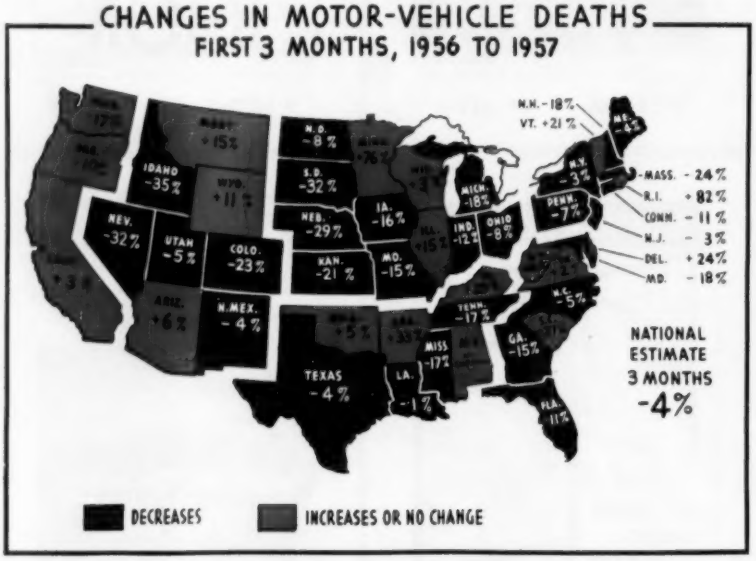
The mayor of the losing city pays off by traveling to the winner and painting a crosswalk in the downtown area.

The report did not say which city won the last contest, but it was Glendale that told the story.

Despite the sweep of red on the map below along the West Coast and in the Middle West, the Nation for the third successive month held the line against the rising toll of traffic death.

Cities, which had heretofore been successful in combating the Grim Reaper, were mainly responsible for the failure to record a third successive monthly drop in deaths. But rural tolls are still high—much too high, mainly due to limited manpower of state police agencies to meet the demands of rising travel and increased exposure.

CHANGES IN MOTOR-VEHICLE DEATHS
FIRST 3 MONTHS, 1956 TO 1957



MOTOR VEHICLE DEATHS
1955, 1956 and 1957

Month	1955	1956	1957	1955-57 Change	1956-57 Change
January	2,810	2,990	2,860	+ 2%	—4%
February	2,319	2,720	2,540	+10%	—7%
March	2,602	2,920	2,920	+12%	0%
Three Months	7,731	8,630	8,320	+ 8%	—4%
April	2,753	2,930			
May	3,101	3,170			
June	2,982	3,290			
July	3,350	3,570			
August	3,386	3,610			
September	3,446	3,710			
October	3,918	3,460			
November	3,559	3,690			
December	4,000	3,940			
Total	38,426	40,000			

All 1955 figures are from N.O.V.S. All other figures are National Safety Council estimates. The 1957 national estimate is arrived at by assuming that the percentage change from 1956 to 1957 in the states reporting for both years reflects the 1956-1957 change in the entire country. Since national estimates made in this way become more accurate as more states report, revisions are made from time to time as new reports are received for the various months. Thus, figures above for 1957 may differ slightly from figures for the same months published in future issues of TRAFFIC SAFETY.

TRAFFIC DEATHS—CITY RECORDS

The table covers only motor-vehicle deaths resulting from traffic accidents that occurred in the city. Nontraffic motor-vehicle deaths (where the accident occurred on home or work premises) are not included; nor are deaths in the city from accidents occurring outside.

Rankings are based on the 1957 registration death rate which is the number of deaths per 10,000 registered motor vehicles on an annual basis. Vehicle registration figures are for the year 1956 and were supplied by R. L. Polk & Company.

Cities are ranked by death rates—from low to high. When two or more cities have exactly the same rate, ranking is by total vehicle registrations—from large to small.

Cities shown in heavy type have improved in 1957 compared with 1956.

The population death rate is the number of deaths per 100,000 population on an annual basis. Populations are as of April, 1950, or later censuses taken by the U. S. Bureau of the Census.

	Three Months 1957	1956	1955	1957 Reg. Rate	1957 Pop. Rate
ALL REPORTING CITIES				2.3	9.2
Group I (1,000,000 and over)					
1. Chicago, Ill.	65	80	92	2.6	7.0
2. Detroit, Mich.	48	59	51	3.0	10.4
All cities in this group				3.4	9.0
3. Philadelphia, Pa.	45	56	41	3.6	8.7
4. Los Angeles, Calif.	104	101	84	3.7	18.5
5. New York, N. Y.	141	159	134	3.9	7.1
Group II (750,000 to 1,000,000)					
1. Baltimore, Md.	14	31	31	1.8	5.9
All cities in this group				2.8	8.9
2. Washington, D. C.	16	23	16	2.9	7.5
3. Cleveland, Ohio	24	28	22	3.1	10.5
4. San Francisco, Calif.	24	19	14	3.4	12.4
Group III (500,000 to 750,000)					
1. Seattle, Wash.	9	17	2	1.4	6.4
2. Boston, Mass.	8	15	20	1.8	4.4
3. Pittsburgh, Pa.	10	14	11	2.0	5.9
4. Buffalo, N. Y.	12	8	17	2.4	8.3
5. Minneapolis, Minn.	14	3	13	2.8	10.7
6. Dallas, Texas	19	3	9	2.9	13.8
All cities in this group				2.9	10.8
7. Milwaukee, Wis.	18	25	11	3.0	11.3
8. Houston, Texas	26	23	20	3.2	17.4
9. Cincinnati, Ohio	16	14	18	3.5	12.7
10. New Orleans, La.	28	22	13	6.6	19.6
Group IV (350,000 to 500,000)					
1. Denver, Colo.	5	7	6	0.9	4.8
2. Memphis, Tenn.	6	12	9	1.7	5.9
3. Indianapolis, Ind.	11	9	7	2.0	10.4
4. Portland, Ore.	13	17	12	2.5	13.9
5. Kansas City, Mo.	11	8	5	2.6	9.6
All cities in this group				2.8	12.0
6. Louisville, Ky.	12	13	11	3.1	12.4
7. San Antonio, Texas	15	15	14	3.2	13.6
8. San Diego, Calif.	15	13	9	3.6	13.8
9. Atlanta, Ga.	25	17	22	5.7	23.3
Group V (200,000 to 350,000)					
1. Norfolk, Va.	0	3	0	0.0	0.0
2. Syracuse, N. Y.	1	3	3	0.5	1.8
3. Wichita, Kan.	3	3	2	0.9	5.3
4. Oklahoma City, Okla.	4	6	2	1.1	6.6
5. Omaha, Neb.	3	3	2	1.1	4.8
6. Tampa, Fla.	4	8	5	1.4	7.4
7. Richmond, Va.	4	11	4	1.5	6.7
8. St. Paul, Minn.	5	7	9	1.5	6.4
9. Toledo, Ohio	6	6	6	1.6	7.9
10. Providence, R. I.	4	2	4	1.7	6.4
11. Rochester, N. Y.	6	3	5	1.7	7.2
12. Dayton, Ohio	6	5	6	1.7	9.8
13. Miami, Fla.	10	3	10	1.9	15.4
14. Fort Worth, Texas	8	14	4	2.1	9.7
All cities in this group				2.1	10.4
15. Honolulu, T. H.	8	3	4	2.4	13.6
16. Birmingham, Ala.	12	12	11	3.9	14.7
17. Akron, Ohio	16	6	5	5.2	23.3
18. Long Beach, Calif.	23	6	5	6.9	36.7
Group VI (100,000 to 200,000)					
1. Bridgeport, Conn.	0	4	2	0.0	0.0
2. Montgomery, Ala.	0	1	3	0.0	0.0
3. Berkeley, Calif.	0	2	0	0.0	0.0
4. Utica, N. Y.	0	0	1	0.0	0.0
5. Salt Lake City, Utah	1	3	5	0.4	2.2
6. Knoxville, Tenn.	1	2	2	0.6	3.2
7. South Bend, Ind.	1	4	0	0.6	3.5
8. Springfield, Mass.	1	7	4	0.7	2.4
9. Hartford, Conn.	1	2	0	0.8	2.3
10. Sacramento, Calif.	2	7	2	0.8	5.1
11. Phoenix, Ariz.	3	10	7	0.8	9.3
12. Lubbock, Texas	1	2	3	0.9	3.8
13. Reading, Pa.	1	0	1	0.9	3.7
14. Wilmington, Del.	2	1	3	1.1	7.2
15. Shreveport, La.	2	4	4	1.2	6.3
16. Trenton, N. J.	2	5	1	1.2	6.3
17. Waterbury, Conn.	1	0	4	1.2	3.8
18. Nashville, Tenn.	3	6	4	1.2	6.9
19. Austin, Texas	2	4	3	1.2	6.0
20. Fresno, Calif.	3	4	4	1.3	11.1
21. Arlington, Va.	2	1	1	1.4	5.9
22. San Jose, Calif.	3	6	1	1.5	9.4
23. Albuquerque, N. M.	3	0	6	1.5	8.7
24. Flint, Mich.	4	0	7	1.5	9.8
25. Fort Wayne, Ind.	3	3	2	1.6	8.3
26. Lincoln, Neb.	2	5	0	1.6	6.9
27. Little Rock, Ark.	2	4	1	1.7	7.5
28. Amarillo, Texas	2	5	1	1.7	8.0
All cities in this group				1.7	8.5
29. Grand Rapids, Mich.	5	11	3	1.8	11.3
30. Des Moines, Iowa	4	3	3	1.8	9.0
31. Evansville, Ind.	3	1	2	2.0	9.3
32. Spokane, Wash.	4	3	5	2.0	8.6
33. Charlotte, N. C.	4	9	8	2.0	11.9
34. Youngstown, Ohio	4	6	2	2.2	9.5
35. Mobile, Ala.	3	7	7	2.2	6.9
36. Yonkers, N. Y.	3	2	3	2.4	7.9
37. Pasadena, Calif.	4	8	3	2.5	15.3
38. Baton Rouge, La.	4	2	3	2.5	12.7
39. Savannah, Ga.	3	4	2	2.6	10.0
40. Erie, Pa.	4	0	3	2.6	12.2
41. Allentown, Pa.	3	0	3	2.6	11.2
42. Tacoma, Wash.	5	4	3	2.8	12.8
43. Duluth, Minn.	3	1	5	2.9	11.5
44. Peoria, Ill.	4	1	0	2.9	14.0
45. Corpus Christi, Texas	5	5	6	3.1	18.5
46. Gary, Ind.	5	6	4	3.1	11.8
47. Rockford, Ill.	5	0	4	3.1	17.9
48. New Haven, Conn.	4	2	1	3.1	9.7
49. Canton, Ohio	5	3	3	3.3	17.1
50. Glendale, Calif.	5	3	2	3.7	19.0
51. Chattanooga, Tenn.	6	7	3	4.4	18.3
52. Elizabeth, N. J.	5	3	2	5.3	17.7
Group VII (50,000 to 100,000)					
1. Lansing, Mich.	0	1	3	0.0	0.0
2. Madison, Wis.	0	0	2	0.0	0.0
3. Pontiac, Mich.	0	1	5	0.0	0.0
4. Pensacola, Fla.	0	1	0	0.0	0.0
5. Pueblo, Colo.	0	0	4	0.0	0.0
6. Springfield, Ohio	0	1	2	0.0	0.0
7. Lexington, Ky.	0	0	1	0.0	0.0
8. Columbus, Ga.	0	1	1	0.0	0.0
9. Terre Haute, Ind.	0	3	2	0.0	0.0
10. Muncie, Ind.	0	4	2	0.0	0.0
11. Racine, Wis.	0	2	0	0.0	0.0
12. Hayward, Calif.	0	0	0	0.0	0.0
13. Lake Charles, La.	0	1	0	0.0	0.0
14. Anderson, Ind.	0	2	1	0.0	0.0
15. Abilene, Texas	0	1	1	0.0	0.0
16. Green Bay, Wis.	0	1	1	0.0	0.0
17. Evanston, Ill.	0	0	0	0.0	0.0
18. Mount Vernon, N. Y.	0	1	1	0.0	0.0
19. Portsmouth, Va.	0	2	0	0.0	0.0
20. Bethlehem, Pa.	0	2	0	0.0	0.0
21. Sioux Falls, S. D.	0	0	3	0.0	0.0
22. Lynn, Mass.	0	2	0	0.0	0.0
23. Asheville, N. C.	0	0	3	0.0	0.0
24. Lorain, Ohio	0	2	0	0.0	0.0
25. Lakewood, Ohio	0	1	2	0.0	0.0
26. New Rochelle, N. Y.	0	2	0	0.0	0.0
27. Oak Park, Ill.	0	2	3	0.0	0.0
28. Berwyn, Ill.	0	0	1	0.0	0.0
29. Alameda, Calif.	0	1	0	0.0	0.0
30. Pittsfield, Mass.	0	1	1	0.0	0.0
31. Brookline, Mass.	0	2	2	0.0	0.0
32. Waltham, Mass.	0	1	2	0.0	0.0
33. Atlantic City, N. J.	0	3	3	0.0	0.0
34. Winston-Salem, N. C.	1	0	0	0.8	4.6
35. Springfield, Ill.	1	1	4	0.8	4.7
36. Burbank, Calif.	1	2	2	0.8	4.5
37. Topeka, Kan.	1	1	0	0.8	4.8
38. Greenville, S. C.	1	2	1	0.9	6.9
39. Colorado Spgs., Colo.	1	1	1	1.0	6.4
40. Charleston, W. Va.	1	0	2	1.0	5.4
41. Springfield, Mo.	1	1	0	1.1	6.0
42. Joliet, Ill.	1	0	1	1.1	6.5
43. Jackson, Mich.	1	3	1	1.1	7.8
44. Niagara Falls, N. Y.	1	2	1	1.1	4.4
45. Binghamton, N. Y.	1	0	1	1.1	5.0
46. Battle Creek, Mich.	1	0	1	1.1	7.8
47. Compton, Calif.	1	2	1	1.1	6.3
48. Hamilton, Ohio	1	2	0	1.1	6.9
49. Davenport, Iowa	1	0	1	1.2	5.4
50. Durham, N. C.	1	1	0	1.2	5.6
51. Augusta, Ga.	1	1	3	1.3	5.6
52. Santa Barbara, Calif.	1	1	2	1.3	7.9
53. Waterloo, Iowa	1	3	0	1.3	6.1
54. Stamford, Conn.	1	1	2	1.3	5.4
55. St. Joseph, Mo.	1	3	1	1.4	5.1
56. Orlando, Fla.	2	4	0	1.4	15.3
57. San Mateo, Calif.	1	2	1	1.4	6.6
58. Richmond, Calif.	1	5	1	1.4	4.0
59. Pawtucket, R. I.	1	0	0	1.4	4.9
60. Bay City, Mich.	1	1	0	1.5	7.6
61. Manchester, N. H.	1	2	2	1.5	4.8
62. Wilkes-Barre, Pa.	1	0	0	1.5	5.2
All cities in this group				1.5	7.5
63. San Bernardino, Calif.	2	6	5	1.6	9.6
64. New Britain, Conn.	1	1	1	1.6	5.4
65. Kalamazoo, Mich.	2	3	0	1.6	13.9
66. Raleigh, N. C.	2	1	0	1.6	12.2
67. Schenectady, N. Y.	2	1	0	1.7	8.7
68. Charleston, S. C.	1	3	0	1.8	5.7
69. Brockton, Mass.	1	0	1	1.8	6.4
70. Greensboro, N. C.	2	2	1	1.8	10.8
71. West Allis, Wis.	1	2	1	2.0	7.2
72. Decatur, Ill.	2	2	1	2.0	10.8
73. Royal Oak, Mich.	2	2	1	2.0	11.3
74. Macon, Ga.	2	0	2	2.0	11.4
75. Dubuque, Iowa	1	2	2	2.0	7.8
76. Passaic, N. J.	1	0	2	2.2	6.9
77. Lancaster, Pa.	2	1	2	2.2	12.5
78. Fort Lauderdale, Fla.	3	2	2	2.3	19.1
79. Wichita Falls, Texas	2	3	0	2.3	8.8
80. East Chicago, Ind.	1	1	0	2.3	7.4
81. Woonsocket, R. I.	1	0	1	2.4	8.0
82. Sioux City, Iowa	2	3	0	2.4	9.5
83. Tucson, Ariz.	5	3	0	2.6	37.9
84. Stockton, Calif.	4	1	3	2.7	21.3
85. Alexandria, Va.	3	1	0	2.7	19.4
86. Waco, Texas	3	4	2	2.8	14.2
87. Santa Monica, Calif.	2	3	3	2.9	10.7
88. Aurora, Ill.	2	0	0	2.9	14.1
89. Portland, Me.	2	4	1	3.0	10.3
90. Jackson, Miss.	4	2	3	3.2	16.3
91. Cedar Rapids, Iowa	3	1	0	3.3	16.6
92. Covington, Ky.	2	2	3	3.3	12.4
93. Wheeling, W. Va.	2	2	1	3.6	13.6
94. Johnston, Pa.	3	0	3	3.6	19.0
95. Columbia, S. C.	5	2	3	4.8	20.8
96. Saginaw, Mich.	7	6	2	5.4	30.1
97. East Orange, N. J.	4	2	2	5.9	20.2
98. Hammond, Ind.	6	1	2	6.7	27.4
99. Gadsden, Ala.	3	0	0	7.9	21.5
100. Fort Smith, Ark.	5	2	2	9.5	35.5
Group VIII (25,000 to 50,000)					
1. Muskegon, Mich.	0	1	0	0.0	0.0
2. Yakima, Wash.	0	1	0	0.0	0.0
3. Odessa, Texas	0	1	0	0.0	0.0
4. Billings, Mont.	0	0	1	0.0	0.0
5. Warren, Ohio	0	1	3	0.0	0.0
6. Tyler, Texas	0	0	1	0.0	0.0
7. Ann Arbor, Mich.	0	0	0	0.0	0.0
8. High Point, N. C.	0	0	0	0.0	0.0
9. Spartanburg, S. C.	0	0	0	0.0	0.0

	Three Months 1957	1956	1955	1957 Reg. Rate	1957 Pop. Rate
10. Poughkeepsie, N. Y.	0	0	0	0.0	0.0
11. Lafayette, Ind.	0	0	0	0.0	0.0
12. Waukegan, Ill.	**0**	**1**	**0**	**0.0**	**0.0**
13. Everett, Wash.	**0**	**1**	**2**	**0.0**	**0.0**
14. Kokomo, Ind.	**0**	**1**	**1**	**0.0**	**0.0**
15. Cheyenne, Wyo.	0	0	0	0.0	0.0
16. Tallahassee, Fla.	0	0	0	0.0	0.0
17. Elmira, N. Y.	0	0	0	0.0	0.0
18. Council Bluffs, Iowa	**0**	**3**	**0**	**0.0**	**0.0**
19. Plainfield, N. J.	0	0	0	0.0	0.0
20. Elyria, Ohio	0	0	0	0.0	0.0
21. West Haven, Conn.	0	0	1	0.0	0.0
22. Richmond, Ind.	0	0	0	0.0	0.0
23. Great Falls, Mont.	**0**	**1**	**0**	**0.0**	**0.0**
24. Rock Island, Ill.	0	0	0	0.0	0.0
25. Owensboro, Ky.	0	0	1	0.0	0.0
26. Zanesville, Ohio	0	0	1	0.0	0.0
27. Hagerstown, Md.	**0**	**1**	**2**	**0.0**	**0.0**
28. Appleton, Wis.	0	0	1	0.0	0.0
29. Enid, Okla.	0	0	1	0.0	0.0
30. Tuscaloosa, Ala.	**0**	**3**	**1**	**0.0**	**0.0**
31. Salina, Kan.	0	0	0	0.0	0.0
32. Bellingham, Wash.	**0**	**1**	**1**	**0.0**	**0.0**
33. Rome, Ga.	**0**	**2**	**1**	**0.0**	**0.0**
34. Cuyahoga Falls, Ohio	**0**	**1**	**0**	**0.0**	**0.0**
35. Parkersburg, W. Va.	**0**	**1**	**0**	**0.0**	**0.0**
36. University City, Mo.	0	0	0	0.0	0.0
37. Sheboygan, Wis.	**0**	**2**	**0**	**0.0**	**0.0**
38. Oshkosh, Wis.	**0**	**1**	**1**	**0.0**	**0.0**
39. Marion, Ohio	0	0	1	0.0	0.0
40. Lwr. Merion Twp., Pa.	**0**	**1**	**2**	**0.0**	**0.0**
41. Bloomington, Ind.	0	0	0	0.0	0.0
42. Fargo, N. D.	0	0	0	0.0	0.0
43. Pocatello, Idaho	**0**	**1**	**0**	**0.0**	**0.0**
44. Champaign, Ill.	**0**	**1**	**0**	**0.0**	**0.0**
45. East Cleveland, Ohio	**0**	**1**	**1**	**0.0**	**0.0**
46. Portsmouth, Ohio	**0**	**2**	**2**	**0.0**	**0.0**
47. Chicopee, Mass.	**0**	**2**	**3**	**0.0**	**0.0**
48. West Hartford, Conn.	**0**	**1**	**0**	**0.0**	**0.0**
49. Meriden, Conn.	**0**	**3**	**2**	**0.0**	**0.0**
50. Eau Claire, Wis.	0	0	2	0.0	0.0
51. Arlington, Mass.*	0	0	1	0.0	0.0
52. Rome, N. Y.	0	0	0	0.0	0.0
53. Elmhurst, Ill.	0	0	0	0.0	0.0
54. Gainesville, Fla.	0	0	0	0.0	0.0
55. Galesburg, Ill.	0	0	0	0.0	0.0
56. Sandusky, Ohio	0	0	0	0.0	0.0
57. Granite City, Ill.	**0**	**2**	**1**	**0.0**	**0.0**
58. Wausau, Wis.	**0**	**1**	**1**	**0.0**	**0.0**
59. Maywood, Ill.	**0**	**1**	**1**	**0.0**	**0.0**
60. Kingston, N. Y.	0	0	0	0.0	0.0
61. Daly City, Calif.	**0**	**1**	**0**	**0.0**	**0.0**
62. Hamden, Conn.	0	0	1	0.0	0.0
63. Vineland, N. J.	**0**	**5**	**1**	**0.0**	**0.0**
64. Jackson, Tenn.	0	0	1	0.0	0.0
65. Lockport, N. Y.	0	0	0	0.0	0.0
66. Norwich, Conn.	**0**	**4**	**0**	**0.0**	**0.0**
67. Mason City, Iowa	0	0	0	0.0	0.0
68. Fitchburg, Mass.	0	0	0	0.0	0.0
69. Walla Walla, Wash.	0	0	0	0.0	0.0
70. Fond du Lac, Wis.	0	0	0	0.0	0.0
71. Hackensack, N. J.	**0**	**1**	**2**	**0.0**	**0.0**
72. Fairmont, W. Va.	0	0	0	0.0	0.0
73. Manitowoc, Wis.	0	0	0	0.0	0.0
74. St. Louis Pk., Minn.	0	0	2	0.0	0.0
75. Kearny, N. J.	**0**	**1**	**3**	**0.0**	**0.0**
76. St. Cloud, Minn.	0	0	0	0.0	0.0
77. Petersburg, Va.	0	0	1	0.0	0.0
78. Chicago Heights, Ill.	**0**	**1**	**2**	**0.0**	**0.0**
79. Fairfield, Conn.	0	0	2	0.0	0.0
80. Bangor, Me.	**0**	**1**	**1**	**0.0**	**0.0**
81. New Kensington, Pa.	**0**	**1**	**0**	**0.0**	**0.0**
82. Milford, Conn.	0	0	2	0.0	0.0
83. Montclair, N. J.	**0**	**1**	**1**	**0.0**	**0.0**
84. New London, Conn.	**0**	**1**	**1**	**0.0**	**0.0**
85. Richfield, Minn.	0	0	0	0.0	0.0
86. Greenville, Miss.	0	0	0	0.0	0.0
87. Burlington, Vt.	0	0	0	0.0	0.0
88. Oak Ridge, Tenn.	**0**	**1**	**0**	**0.0**	**0.0**
89. Bristol, Conn.	0	0	1	0.0	0.0
90. Shaker Heights, Ohio	0	0	0	0.0	0.0
91. Urbana, Ill.	0	0	0	0.0	0.0
92. Winona, Minn.	**0**	**3**	**2**	**0.0**	**0.0**
93. Concord, N. H.	**0**	**1**	**1**	**0.0**	**0.0**
94. Grand Forks, N. D.	0	0	0	0.0	0.0
95. Annapolis, Md.	0	0	0	0.0	0.0
96. Boise, Idaho	1	1	1	1.1	11.6
97. Mansfield, Ohio	**1**	**2**	**1**	**1.3**	**9.2**
98. Reno, Nev.	1	0	1	1.4	12.3
99. Palo Alto, Calif.	1	1	0	1.4	9.8
All cities in this group				1.4	7.2
100. White Plains, N. Y.	1	0	0	1.5	9.2
101. Elkhart, Ind.	1	0	0	1.6	11.2
102. Elgin, Ill.	1	1	1	1.8	8.4
103. Easton, Pa.	1	1	0	1.9	11.2
104. Parma, Ohio	1	1	1	1.9	13.8
105. Vallejo, Calif.	1	0	1	1.9	11.5
106. Quincy, Ill.	**1**	**2**	**0**	**2.1**	**9.4**
107. La Crosse, Wis.	1	0	0	2.1	8.4
108. Bloomfield, N. J.	1	1	1	2.1	8.1
109. Albany, Ga.	**1**	**2**	**0**	**2.1**	**12.8**
110. Culver City, Calif.	1	0	1	2.1	12.7
111. Jamestown, N. Y.	1	0	0	2.1	9.2
112. Wauwatosa, Wis.	1	1	1	2.2	12.0
113. Clearwater, Fla.	**1**	**2**	**0**	**2.2**	**13.7**
114. Newburgh, N. Y.	1	0	1	2.2	12.5
115. Hamtramck, Mich.	1	1	1	2.3	9.3
116. Lincoln Park, Mich.	**1**	**2**	**0**	**2.3**	**13.7**
117. Greenwich, Conn.	1	1	2	2.5	9.8
118. Rochester, Minn.	1	0	0	2.5	13.4
119. Ferndale, Mich.	1	0	1	2.5	13.5
120. Danbury, Conn.	1	0	0	2.5	13.2
121. Barberton, Ohio	1	0	0	2.6	14.4
122. East Hartford, Conn.	1	1	0	2.6	13.4
123. Coral Gables, Fla.	**1**	**3**	**0**	**2.6**	**13.7**
124. Newport News, Va.	1	0	0	2.7	9.4
125. Wyandotte, Mich.	2	0	1	2.8	21.7
126. West Orange, N. J.	1	1	1	2.9	14.0
127. Watertown, N. Y.	1	1	0	2.9	11.6
128. Torrington, Conn.	1	0	0	3.0	14.4
129. San Leandro, Calif.	2	1	2	3.0	24.5
130. Freeport, Ill.	**1**	**2**	**0**	**3.3**	**16.0**
131. Midland, Texas	2	1	0	3.4	24.2
132. Kettering, Ohio	2	0	0	3.5	21.0
133. Teaneck, N. J.	1	0	3	3.5	11.8
134. Superior, Wis.	**1**	**2**	**0**	**3.8**	**11.3**
135. Wilmington, N. C.	2	2	0	3.9	17.8
136. Middleton, Conn.	1	0	0	3.9	13.5
137. Moline, Ill.	2	1	1	4.1	19.8
138. Lynchburg, Va.	2	1	1	4.3	16.8
139. Daytona Beach, Fla.	2	1	0	4.7	26.5
140. Danville, Va.	2	0	0	4.8	17.9
141. Rapid City, S. D.	2	0	0	4.8	31.6
142. Belmont, Mass.	1	1	0	4.8	13.9
143. Pine Bluff, Ark.	2	1	0	4.9	20.1
144. Stratford, Conn.	2	0	0	5.0	24.0
145. Beloit, Wis.	2	0	0	5.0	27.0
146. Euclid, Ohio	**2**	**3**	**0**	**5.2**	**19.3**
147. Bloomington, Ill.	2	0	0	5.2	22.2
148. Michigan City, Ind.	2	0	0	5.2	25.2
149. Linden, N. J.	2	1	2	5.3	26.1
150. Steubenville, Ohio	2	1	0	5.3	22.3
151. Middletown, Ohio	3	0	1	6.0	35.6
152. West Covina, Calif.	2	1	3	6.5	22.2
153. Vancouver, Wash.	4	1	0	6.6	37.8
154. Mishawaka, Ind.	3	0	0	7.5	36.5
155. Burlington, Iowa	3	1	0	8.4	39.2
156. Manchester, Conn.	4	2	1	11.3	46.9
157. Norwalk, Conn.	4	3	2	11.3	32.3
158. Revere, Mass.	4	2	1	16.2	40.4

Group IX (10,000 to 25,000)

1. Modesto, Calif.	**0**	**1**	**0**	**0.0**	**0.0**
2. Casper, Wyo.	0	0	0	0.0	0.0
3. St. Clair Shores, Mich.	**0**	**2**	**3**	**0.0**	**0.0**
4. Kingsport, Tenn.	0	0	0	0.0	0.0
5. Aurora, Colo.	0	0	0	0.0	0.4
6. Medford, Ore.	0	0	2	0.0	0.0
7. Benton Harbor, Mich.	0	0	0	0.0	0.0
8. Santa Cruz, Calif.	**0**	**1**	**0**	**0.0**	**0.0**
9. Butler, Pa.	0	0	1	0.0	0.0
10. Klamath Falls, Ore.	0	0	0	0.0	0.0
11. Robbinsdale, Minn.	0	0	0	0.0	0.0
12. So. Euclid, Ohio	**0**	**1**	**0**	**0.0**	**0.0**
13. Holland, Mich.	0	0	0	0.0	0.0
14. Pasadena, Texas	0	0	2	0.0	0.0
15. Monroe, Mich.	0	0	0	0.0	0.0
16. Boulder, Colo.	0	0	0	0.0	0.0
17. Fort Myers, Fla.	0	0	0	0.0	0.0
18. Janesville, Wis.	0	0	0	0.0	0.0
19. La Mesa, Calif.	0	0	1	0.0	0.0
20. Westfield, N. J.	0	0	0	0.0	0.0
21. Fair Lawn, N. J.	0	0	2	0.0	0.0
22. Waukesha, Wis.	**0**	**2**	**0**	**0.0**	**0.0**
23. Austin, Minn.	0	0	0	0.0	0.0
24. Sumter, S. C.	0	0	1	0.0	0.0
25. Rock Hill, S. C.	**0**	**1**	**1**	**0.0**	**0.0**
26. Lodi, Calif.	0	0	0	0.0	0.0
27. El Cerrito, Calif.	**0**	**1**	**0**	**0.0**	**0.0**
28. Uniontown, Pa.	0	0	1	0.0	0.0
29. Longview, Wash.	0	0	0	0.0	0.0
30. Garland, Texas	0	0	0	0.0	0.0
31. Bell, Calif.	**0**	**1**	**0**	**0.0**	**0.0**
32. Lawrence, Kan.	0	0	0	0.0	0.0
33. Mankato, Minn.	**0**	**2**	**0**	**0.0**	**0.0**
34. Hazel Park, Mich.	0	0	1	0.0	0.0
35. Statesville, N. C.	0	0	0	0.0	0.0
36. Rahway, N. J.	**0**	**1**	**4**	**0.0**	**0.0**
37. Kinston, N. C.	0	0	0	0.0	0.0
38. Morristown, N. J.	0	0	0	0.0	0.0
39. Richland, Wash.	0	0	0	0.0	0.0
40. Fremont, Ohio	**0**	**2**	**0**	**0.0**	**0.0**
41. La Grange, Ill.	0	0	0	0.0	0.0
42. Floral Park, N. Y.	0	0	0	0.0	0.0
43. Kenmore, N. Y.	0	0	0	0.0	0.0
44. Meadville, Pa.	0	0	0	0.0	0.0
45. Great Bend, Kan.	0	0	1	0.0	0.0
46. Hanford, Calif.	0	0	0	0.0	0.0
47. Orange, Calif.	**0**	**2**	**3**	**0.0**	**0.0**
48. Ames, Iowa	0	0	0	0.0	0.0
49. Plainview, Texas	0	0	0	0.0	0.0
50. Wooster, Ohio	0	0	0	0.0	0.0
51. Bismarck, N. D.	0	0	0	0.0	0.0
52. Port Chester, N. Y.	**0**	**1**	**0**	**0.0**	**0.0**
53. Sedalia, Mo.	0	0	0	0.0	0.0
54. Tiffin, Ohio	0	0	0	0.0	0.0
55. Whitefish Bay, Wis.	0	0	0	0.0	0.0
56. Frederick, Md.	0	0	1	0.0	0.0
57. Owosso, Mich.	0	0	0	0.0	0.0
58. Bloomington, Minn.	**0**	**1**	**2**	**0.0**	**0.0**
59. Huntington, Ind.	**0**	**1**	**0**	**0.0**	**0.0**
60. Frankfort, Ind.	0	0	0	0.0	0.0
61. Goshen, Ind.	0	0	0	0.0	0.0
62. North Platte, Neb.	0	0	0	0.0	0.0
63. East Haven, Conn.	0	0	0	0.0	0.0
64. Pittsburg, Calif.	**0**	**1**	**0**	**0.0**	**0.0**
65. Borger, Texas	**0**	**1**	**0**	**0.0**	**0.0**
66. Bristol, Pa.	0	0	0	0.0	0.0
67. Hibbing, Minn.	0	0	0	0.0	0.0
68. Ashland, Ohio	**0**	**1**	**0**	**0.0**	**0.0**
69. Corvallis, Ore.	**0**	**3**	**0**	**0.0**	**0.0**
70. Jeffersonville, Ind.	0	0	1	0.0	0.0
71. Aberdeen, S. D.	**0**	**1**	**0**	**0.0**	**0.0**
72. Coffeyville, Kan.	0	0	0	0.0	0.0
73. Pittsburg, Kan.	0	0	0	0.0	0.0
74. Valparaiso, Ind.	0	0	0	0.0	0.0
75. Connersville, Ind.	0	0	1	0.0	0.0
76. Streator, Ill.	0	0	0	0.0	0.0
77. Peru, Ind.	0	0	0	0.0	0.0
78. Cranford, N. J.	0	0	0	0.0	0.0
79. Mt. Vernon, Ill.	0	0	1	0.0	0.0
80. Cape Girardeau, Mo.	0	0	1	0.0	0.0
81. W. Springfield, Mass.	**0**	**1**	**0**	**0.0**	**0.0**
82. Sterling, Ill.	0	0	0	0.0	0.0
83. Emporia, Kan.	0	0	0	0.0	0.0
84. So. Portland, Me.	0	0	0	0.0	0.0
85. Hillside, N. J.	0	0	0	0.0	0.0
86. Wilmette, Ill.	0	0	0	0.0	0.0
87. Leominster, Mass.	0	0	0	0.0	0.0
88. Wisconsin Rpds., Wis.	0	0	1	0.0	0.0
89. Xenia, Ohio	0	0	0	0.0	0.0
90. Bellevue, Pa.	0	0	0	0.0	0.0
91. East Lansing, Mich.	0	0	0	0.0	0.0
92. McAlester, Okla.	0	0	0	0.0	0.0
93. Highland Park, Texas	0	0	0	0.0	0.0
94. Monroe, N. C.	**0**	**1**	**0**	**0.0**	**0.0**
95. Wallingford, Conn.	**0**	**2**	**0**	**0.0**	**0.0**
96. Moorhead, Minn.	0	0	1	0.0	0.0
97. Newport Beach, Calif.	0	0	0	0.0	0.0
98. Suffolk, Va.	0	0	1	0.0	0.0
99. Elmwood Park, Ill.	**0**	**1**	**1**	**0.0**	**0.0**
100. Greenwood, Miss.	0	0	0	0.0	0.0
101. Brainerd, Minn.	0	0	0	0.0	0.0
102. Massena, N. Y.	0	0	0	0.0	0.0
103. Park Forest, Ill.	0	0	0	0.0	0.0
104. Antioch, Calif.	**0**	**1**	**0**	**0.0**	**0.0**
105. Canton, Ill.	0	0	0	0.0	0.0
106. No. Adams, Mass.	**0**	**1**	**1**	**0.0**	**0.0**
107. San Marino, Calif.	**0**	**1**	**0**	**0.0**	**0.0**
108. Newton, Kan.	0	0	0	0.0	0.0
109. Norfolk, Neb.	0	0	0	0.0	0.0
110. Sweetwater, Texas	**0**	**1**	**1**	**0.0**	**0.0**
111. Attleboro, Mass.	0	0	1	0.0	0.0
112. Muskegon Hts., Mich.	0	0	0	0.0	0.0
113. Stevens Point, Wis.	**0**	**1**	**0**	**0.0**	**0.0**
114. Mt. Pleasant, Mich.	**0**	**1**	**0**	**0.0**	**0.0**
115. Boone, Iowa	0	0	1	0.0	0.0
116. Owatonna, Minn.	0	0	0	0.0	0.0
117. Faribault, Minn.	**0**	**1**	**0**	**0.0**	**0.0**
118. Rocky River, Ohio	0	0	0	0.0	0.0
119. Hawthorne, N. J.	0	0	0	0.0	0.0
120. East Moline, Ill.	0	0	0	0.0	0.0
121. Brawley, Calif.	**0**	**1**	**0**	**0.0**	**0.0**
122. Winfield, Kan.	0	0	0	0.0	0.0
123. Lamesa, Texas	0	0	0	0.0	0.0
124. Fergus Falls, Minn.	0	0	0	0.0	0.0
125. Watertown, Wis.	0	0	1	0.0	0.0
126. Bristol, Va.	0	0	1	0.0	0.0
127. St. Joseph, Mich.	0	0	0	0.0	0.0
128. So. Orange, N. J.	0	0	0	0.0	0.0
129. River Rouge, Mich.	**0**	**2**	**2**	**0.0**	**0.0**
130. Logan, Utah	0	0	1	0.0	0.0
131. Mamaroneck, N. Y.	0	0	0	0.0	0.0
132. Winnetka, Ill.	0	0	0	0.0	0.0
133. Needham, Mass.	**0**	**1**	**0**	**0.0**	**0.0**
134. Albany, Calif.	0	0	0	0.0	0.0
135. Gardner, Mass.	0	0	0	0.0	0.0
136. Shelton, Conn.	0	0	0	0.0	0.0
137. Hopewell, Va.	0	0	0	0.0	0.0
138. Garden City, Kan.	**0**	**2**	**0**	**0.0**	**0.0**
139. Conneaut, Ohio	0	0	0	0.0	0.0
140. Mitchell, S. D.	0	0	0	0.0	0.0
141. Rye, N. Y.	0	0	1	0.0	0.0
142. Atchison, Kan.	0	0	0	0.0	0.0
143. Marshfield, Wis.	0	0	0	0.0	0.0
144. Darien, Conn.	**0**	**1**	**2**	**0.0**	**0.0**
145. Central Falls, R. I.	0	0	0	0.0	0.0
146. Escanaba, Mich.	**0**	**1**	**1**	**0.0**	**0.0**
147. Beaver Dam, Wis.	0	0	0	0.0	0.0
148. Virginia, Minn.	0	0	0	0.0	0.0
149. Albion, Mich.	**0**	**1**	**0**	**0.0**	**0.0**
150. State College, Pa.	0	0	0	0.0	0.0
151. Vernon, Conn.	**0**	**1**	**0**	**0.0**	**0.0**
152. Du Bois, Pa.	0	0	0	0.0	0.0

	Three Months 1957	1956	1955	1957 Reg. Rate	1957 Pop. Rate
153. Hornell, N. Y.	0	0	0	0.0	0.0
154. Bellefontaine, Ohio	0	0	0	0.0	0.0
155. Charles City, Iowa	0	0	0	0.0	0.0
156. Red Wing, Minn.	0	0	0	0.0	0.0
157. North Miami, Fla.	0	0	0	0.0	0.0
158. Rialto, Calif.	**0**	**1**	**—**	**0.0**	**0.0**
159. Bemedji, Minn.	0	0	0	0.0	0.0
160. Cadillac, Mich.	0	0	1	0.0	0.0
161. Homewood, Ill.	0	0	1	0.0	0.0
162. Ironwood, Mich.	**0**	**1**	**0**	**0.0**	**0.0**
163. Winchester, Conn.	0	0	0	0.0	0.0
164. La Salle, Ill.	0	0	0	0.0	0.0
165. Windsor, Conn.	**0**	**2**	**0**	**0.0**	**0.0**
166. Two Rivers, Wis.	0	0	0	0.0	0.0
167. Groton, Conn.	0	0	1	0.0	0.0
168. Milford, Mass.	0	0	0	0.0	0.0
169. Bellaire, Ohio	0	0	2	0.0	0.0
170. Branford, Conn.	0	0	0	0.0	0.0
171. Rantoul, Ill.	0	0	0	0.0	0.0
172. West Lafayette, Ind.	0	0	0	0.0	0.0
173. Webster, Mass.	0	0	0	0.0	0.0
174. Stoughton, Mass.	0	0	1	0.0	0.0
175. Ashland, Wis.	0	0	0	0.0	0.0
176. Amherst, Mass.	0	0	0	0.0	0.0
177. Grosse Pt. Woods, Mich.	0	0	0	0.0	0.0
178. Donora, Pa.	0	0	0	0.0	0.0
179. Watertown, Conn.	0	0	0	0.0	0.0
180. Enfield, Conn.	**0**	**1**	**1**	**0.0**	**0.0**
181. Birmingham, Mich.	1	0	1	1.5	25.8
All cities in this group				1.7	10.0
182. Mt. Clemens, Mich.	1	0	1	2.1	23.5
183. Ypsilanti, Mich.	1	0	0	2.5	21.9
184. Greeley, Colo.	1	0	0	2.7	19.6

	Three Months 1957	1956	1955	1957 Reg. Rate	1957 Pop. Rate
185. Findlay, Ohio	1	1	2	2.8	16.8
186. La Porte, Ind.	1	0	0	3.2	19.6
187. Redlands, Calif.	1	1	2	3.4	18.8
188. Ocala, Fla.	**1**	**5**	**0**	**3.4**	**34.2**
189. Ottawa, Ill.	1	0	0	4.0	22.2
190. Edina, Minn.	1	0	0	4.0	18.2
191. Hollywood, Fla.	2	0	2	4.0	55.6
192. Monterey, Calif.	1	0	2	4.1	18.3
193. Denison, Texas	1	0	1	4.1	22.9
194. Muscatine, Iowa	**1**	**3**	**0**	**4.2**	**21.1**
195. Reidsville, N. C.	1	0	1	4.3	34.2
196. Marietta, Ohio	1	0	1	4.3	25.0
197. Texarkana, Ark.	1	0	1	4.4	20.3
198. Oswego, N. Y.	1	0	0	4.6	17.7
199. Las Cruces, N. M.	1	1	1	4.7	32.5
200. Stillwater, Okla.	1	0	0	4.7	19.8
201. Alpena, Mich.	1	1	0	4.8	30.5
202. Cedar Falls, Iowa	1	1	0	4.8	28.0
203. St. Augustine, Fla.	1	0	0	4.8	29.4
204. Arkansas City, Kan.	1	0	0	4.9	28.4
205. Victoria, Texas	2	0	0	4.9	49.7
206. Niles, Ohio	1	1	0	5.2	23.8
207. Brookfield, Ill.	1	0	0	5.4	20.4
208. Astoria, Ore.	1	1	0	5.5	32.5
209. Monrovia, Calif.	2	1	0	5.6	34.2
210. Sault Ste. Marie, Mich.	1	0	0	5.6	22.3
211. Naugatuck, Conn.	1	0	0	5.7	22.9
212. Windham, Conn.	1	1	0	5.9	25.2
213. Wethersfield, Conn.	1	1	1	6.1	32.0
214. Niles, Mich.	2	0	0	6.2	61.1
215. Carlsbad, N. M.	2	1	0	6.3	44.4
216. Livermore, Calif.	1	0	0	6.6	39.2
217. Ansonia, Conn.	1	0	0	6.6	21.4
218. Napa, Calif.	3	1	0	6.6	78.4

	Three Months 1957	1956	1955	1957 Reg. Rate	1957 Pop. Rate
219. Mansfield, Conn.	1	1	3	6.8	40.0
220. Bowling, Green, Ohio	1	0	0	6.9	33.3
221. Webster Groves, Mo.	2	0	0	7.0	34.2
222. River Forest, Ill.	1	0	0	7.2	34.8
223. Westport, Conn.	2	1	0	7.4	68.4
224. Livonia, Mich.	3	2	3	7.8	68.6
225. Cudahy, Wis.	1	0	0	8.2	32.8
226. Beacon, N. Y.	1	0	0	8.2	28.6
227. Kennewick, Wash.	2	0	0	8.5	59.7
228. Martinsburg, W. Va.	2	0	0	8.6	51.3
229. Ridgefield Pk., N. J.	1	0	1	8.7	33.3
230. Albert Lea, Minn.	2	0	0	8.7	59.3
231. Southington, Conn.	1	0	1	9.2	30.5
232. Calumet City, Ill.	2	1	0	9.3	40.0
233. Grosse Pte. Pk., Mich.	1	0	0	9.3	30.5
234. Berkley, Mich.	2	0	0	9.4	44.7
235. Derby, Conn.	1	0	0	9.7	38.8
236. Lake Worth, Fla.	3	0	0	9.9	78.4
237. El Dorado, Kan.	2	0	0	9.9	67.8
238. Roseville, Mich.	4	0	0	10.5	101.3
239. Salisbury, N. C.	4	0	1	11.3	79.6
240. Killingly, Conn.	1	0	0	11.6	40.0
241. So. Milwaukee, Wis.	2	1	0	12.4	62.0
242. Fort Thomas, Ky.	2	0	0	17.2	73.4
243. Endicott, N. Y.	5	1	0	17.4	99.5
244. Van Wert, Ohio	3	0	0	19.7	115.4
245. Stonington, Conn.	1	0	0	26.7	33.9
CANADIAN CITIES					
Vancouver, B. C.	8	9	4	—	9.3
Toronto, Ont.	32	18	15	—	9.8
Montreal, Que.	34	21	18	—	13.3
Hamilton, Ont.	7	8	4	—	13.4

TRAFFIC DEATHS—STATE RECORDS

Deaths are reported by state traffic authorities.

Population Rate: U. S. population rate is the estimated annual number of deaths per 100,000 population, assuming that deaths for the rest of the year will follow the normal seasonal pattern. State population rate is the estimated annual number of deaths per 100,000 population, assuming that the monthly average of deaths will remain at the present average for the rest of the year. Population rates are based on July 1, 1956, population estimates, U. S. Bureau of the Census, Washington, D. C.

States shown in heavy type have improved in 1957 compared with 1956, or showed no change. All figures are provisional.

Mileage Rate: The number of deaths per 100 million vehicle miles of travel.

(Figures in parenthesis following the 1957 mileage rate indicate the number of months for which the mileage rate is calculated for each state.)

	Months Reported	Deaths 1957	1956	1955	% Changes 1956 to 1957	1955 to 1957	1957 Pop. Rate	1957 Mile Rate	
TOTAL U.S.	3	8,320	8,630	7,731	— 4%	+ 8%	19.9	5.7	(1)
Ala.	3	210	209	162	0%	+ 30%	26.8	5.7	(1)
Ariz.	3	116	109	71	+ 6%	+ 63%	43.9	10.2	(1)
Ark.	3	130	98	53	+ 33%	+145%	28.7	—	—
Calif.	3	778	757	628	+ 3%	+ 24%	23.2	5.3	(1)
Colo.	3	57	74	63	— 23%	— 10%	14.1	3.5	(1)
Conn.	3	57	64	74	— 11%	— 23%	10.2	2.6	(1)
Del.	3	21	17	18	+ 24%	+ 17%	20.9	4.8	(1)
D. of C.	3	16	23	16	— 30%	0%	7.4	2.5	(1)
Fla.	3	304	340	254	— 11%	+ 20%	32.3	6.6	(1)
Ga.	3	219	258	219	— 15%	0%	23.6	4.7	(1)
Idaho	3	28	43	27	— 35%	+ 4%	17.9	—	—
Ill.	3	480	418	456	+ 15%	+ 5%	20.4	6.2	(1)
Ind.	3	224	254	236	— 12%	— 5%	20.3	4.9	(1)
Iowa	3	128	153	117	— 16%	+ 9%	19.0	6.0	(2)
Kans.	3	115	145	119	— 21%	— 4%	21.9	4.0	(1)
Ky.	3	183	144	177	+ 27%	+ 3%	24.3	8.3	(1)
La.	3	174	175	134	— 1%	+ 30%	23.2	7.1	(2)
Me.	3	24	25	26	— 4%	— 8%	10.5	3.7	(2)
Md.	3	99	121	125	— 18%	— 21%	14.1	3.7	(1)
Mass.	3	87	114	109	— 24%	— 20%	7.2	—	—
Mich.	3	318	386	342	— 18%	— 7%	16.9	4.1	(1)
Minn.	3	134	76	116	+ 76%	+ 16%	16.5	4.6	(1)
Miss.	3	95	115	109	— 17%	— 13%	17.9	5.0	(1)
Mo.	3	209	247	185	— 15%	+ 13%	19.6	5.1	(1)
Mont.	3	38	33	41	+ 15%	— 7%	23.8	2.9	(1)
Neb.	3	54	76	68	— 29%	— 21%	15.3	1.7	(1)
Nev.	3	19	28	37	— 32%	— 49%	30.8	—	—

	Months Reported	Deaths 1957	1956	1955	% Changes 1956 to 1957	1955 to 1957	1957 Pop. Rate	1957 Mile Rate	
N. H.	3	14	17	22	— 18%	— 36%	10.0	3.2	(2)
N. J.	3	185	191	160	— 3%	+ 16%	13.7	3.5	(1)
N. M.	3	76	79	69	— 4%	+ 10%	37.3	5.2	(1)
N. Y.	3	435	448	396	— 3%	+ 10%	10.7	4.2	(1)
N. C.	3	231	243	226	— 5%	+ 2%	20.9	7.2	(1)
N. D.	3	12	13	16	— 8%	— 25%	7.3	—	—
Ohio	3	408	442	399	— 8%	+ 2%	17.9	4.9	(1)
Okla.	3	136	130	129	+ 5%	+ 5%	24.3	5.2	(1)
Ore.	3	89	81	82	+ 10%	+ 9%	20.7	4.9	(1)
Pa.	3	360	389	318	— 7%	+ 13%	13.1	4.3	(1)
R. I.	3	20	11	20	+ 82%	0%	9.7	1.8	(1)
S. C.	3	186	147	150	+ 27%	+ 24%	31.6	8.8	(1)
S. D.	3	21	31	36	— 32%	— 42%	12.1	5.3	(1)
Tenn.	3	139	168	161	— 17%	— 14%	16.0	5.5	(1)
Texas	3	542	564	541	— 4%	0%	24.3	5.1	(1)
Utah	3	41	43	35	— 5%	+ 17%	20.2	—	—
Vt.	3	23	19	17	+ 21%	+ 35%	24.9	6.4	(1)
Va.	3	173	169	159	+ 2%	+ 9%	19.0	6.3	(1)
Wash.	3	112	96	84	+ 17%	+ 33%	16.8	4.4	(1)
W. Va.	3	89	78	76	+ 14%	+ 17%	18.0	—	—
Wis.	3	181	175	159	+ 3%	+ 14%	19.2	5.9	(1)
Wyo.	3	30	27	22	+ 11%	+ 36%	37.4	7.0	(1)
CANADIAN PROVINCES									
Alta.	3	29	34	44	— 15%	— 34%	12.3	.....	.....
B. C.	1	14	16	13	— 13%	+ 8%	14.4	.....	.....
Man.	2	15	14	9	+ 7%	+ 67%	11.6	.....	.....
Sask.	2	5	5	8	0%	— 38%	2.4	.....	.....

14-INCH TIRES PASS SKID TEST

From Page 12

recording the skidding distance. The same driver made all the runs, so no differences in driving technique would distort the results.

Cornering ability was tested by driving the car in a 400-foot circle at gradually increasing speed. When the test tires had taken all the centrifugal force they could handle and began to slide, the test wheel recorded the speed. The effect of wind and other variables made the researchers dissatisfied with the cornering test results generally, but one clear conclusion was that mud-snow tires show a marked improvement over regular highway tires in cornering.

Transferring weight to the rear wheels improved performance, especially starting traction. Many a farmer insists that his pickup truck "won't pull the hat off your head" until he throws some weight in the bed. The snow-plagued motorist can take a tip from the farmer and put a bag of sand in the trunk, because the test results proved the point.

One thing Mr. Late Model may not know is that his high-tailed 1957 beauty has more weight on the front wheels. A few years ago a car's weight was about 50-50 front and back. But one current model has 57 per cent of its weight on the front wheels. The low-priced car used in the 1957 skid tests weighed in at 54-46 in favor of the front. Four or even 7 per cent doesn't seem to be much, but in skid control and braking problems, weight distribution is far from a minor consideration in the delicate balance involved.

As weight has moved forward, stopping distances have been moving forward, too. It was high time someone looked into the matter of weight distribution, the committee believed, so several hundred pounds of lead shot were packed along with the long-handled underwear and Eskimo parkas.

The researchers loaded the test cars with 300, then 600, pounds of lead shot. The weight was placed first in the front, then in the center, and finally in the rear. Performance invariably rose as the weight on the rear wheels increased.

An old wives' tale current since the development of the pneumatic tire proclaims that the way to get winter traction is to broaden your base by letting air out of the tires. The Pine Lake investigators labeled this nonsense in the same category as taking a belt of booze for snakebite. It can actually make matters worse as far as winter traction is concerned, and it's a quick way to crack up the sidewalls of your tires.

The primary objective of the tests was accomplished—an appraisal of the

MOTOR-VEHICLE DEATHS AND INJURIES, BY STATES 1957 and 1956

Forty states and the District of Columbia reported their death and injury experience for January 1957. Twenty-two states and the District of Columbia showed decreases in deaths, two states recorded no change and sixteen states reported increases compared with January 1956. For all reporting states and the District the decrease in deaths was 3 per cent compared with the same month in 1956.

The injury experience of all reporting states and the District for January 1957 showed an increase of 9 per cent compared with the same period last year. Twenty-four states and the District showed increases, two reported no change and fourteen reported a decrease.

MOTOR-VEHICLE DEATHS AND INJURIES, BY STATES 1957 and 1956

	Months Reported **	Deaths		Injuries		% Changes 1956 to 1957		1957 Ratio of Injuries to Deaths
		1957	1956	1957	1956	Deaths	Injuries	
TOTAL U.S.	—	2,272	2,343	84,503	77,641	— 3	+ 9	37
Ala.	1	49	66	322*	455*	—26	—29	7
Ariz.	1	43	49	643	624	—12	+ 3	15
Ark.	1	50	37	233	229	+35	+ 2	5
Calif.	1	261	229	10,801	9,624	+14	+12	41
Colo.								
Conn.	1	18	20	1,966	1,527	—10	+29	109
Del.	1	7	5	173	145	+40	+19	25
D. of C.	1	5	7	466	448	—29	+ 4	93
Fla.	1	105	93	2,970	3,137	+13	— 5	28
Ga.	1	57	90	689	862	—37	—20	12
Idaho	1	12	15	193	251	—20	—23	16
Ill.	1	165	126	8,056	6,470	+31	+25	49
Ind.	1	81	101	3,104	2,833	—20	+10	38
Ia.	1	34	62	1,671	1,433	—45	+17	49
Kans.	1	33	44	741	803	—25	— 8	22
Ky.	1	63	51	867	943	+24	— 8	14
La.	1	61	47	624	658	+30	— 5	10
Me.	1	7	9	459	216	—22	+113	66
Md.	1	29	49	1,273	1,369	—41	— 7	44
Mass.								
Mich.	1	98	143	4,269	4,763	—31	—10	44
Minn.	1	46	21	1,749	1,521	+119	+15	38
Miss.	1	32	52	483	474	—38	+ 2	15
Mo.	1	74	76	870	785	— 3	+11	12
Mont.	1	8	14	172	167	—43	+ 3	22
Neb.	1	9	24	604	633	—63	— 5	67
Nev.								
N. H.	1	6	10	610	468	—40	+30	102
N. J.	1							
N. M.	1	31	23	301	262	+35	+15	10
N. Y.	1	145	153	19,039	15,945	— 5	+19	131
N. C.	1	97	90	1,467	1,281	+ 8	+15	15
N. D.	1	2	5	110	109	—60	+ 1	55
Ohio	1	140	149	5,907	5,888	— 6	0	42
Okla.	1	41	53	1,131	1,023	—23	+11	28
Ore.	1	27	27	1,140	1,400	0	—19	42
Pa.								
R. I.								
S. C.	1	59	47	845	875	+26	— 3	14
S. D.	1	9	14	160	168	—36	— 5	18
Tenn.	1	55	48	971	897	+15	+ 8	18
Texas	1	178	172	4,934	4,930	+ 3	0	28
Utah								
Vt.	1	7	5	290	132	+40	+120	41
Va.								
Wash.	1	34	34	1,697	1,680	0	+ 1	50
W. Va.	1	32	22	520	543	+45	— 4	16
Wis.	1	62	61	1,983	1,670	+ 2	+19	32
Wyo.								

*Rural injuries only.
**Death and injury totals cover the months reported by all states as indicated in this column.

winter safety of the 14-inch tires. While they proved themselves almost 5 per cent better, the Council's committee underscored this footnote to the test data: *a 5 per cent improvement merely means that you will skid 190 feet instead of 200 on glare ice at 20 mph!*

Esso Establishes Highway Safety Dept.

Stanley C. Hope, president of Esso Standard Oil Company, announced that Esso Standard will devote increased attention to long-range studies and programs in the fields of traffic safety and highway development.

His company is establishing a new Highway Traffic Department of the company to coordinate these activities.

Sponsorship of highway-safety research, education, enforcement and engineering projects will be a major part of the overall program, according to Mr. Hope. These will be carried out by the Esso Safety Foundation, which will be under the supervision of the Highway Traffic Department.

John J. Hall has been named manager of the new department, and Harry J. Green has been named assistant manager.

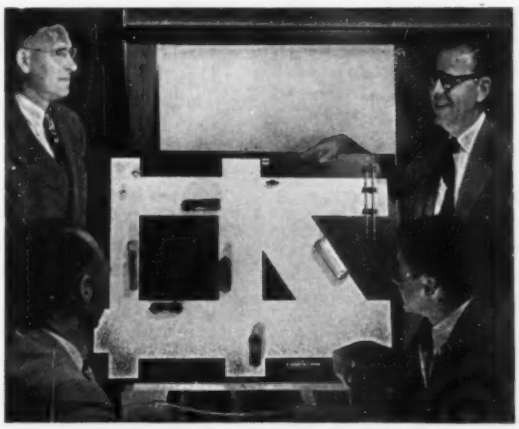
Mr. Hall is also director of the Esso Safety Foundation. The foundation was reactivated by Esso Standard in 1954, and Mr. Hall was appointed its director, shortly after the White House Conference on Highway Safety prompted increased activity in this field.

One of the organizers of the American Association of Motor Vehicle Administrators, Mr. Hall is the association's only honorary member. He is also a charter member of the National Conference on Street and Highway Safety, and a member of the Advisory Committee of the Center for Safety Education at New York University, and of the Citizens' Traffic Safety Board of New York City.

Mr. Green, a former district sales manager for Esso Standard at Albany, has been a member of the firm's New York Public Relations Department for more than a year. He was public-relations representative for the New York Sales Division of Esso Standard from 1953 through 1955.

Functions of its new Highway Traffic Department, Esso Standard reported, will include studies of the development of the interstate and other Federal-aid highway systems and the effects of such new roads on population and business, petroleum-industry operations and traffic safety.

The department will work closely with a new Highway Development Committee organized by Esso Standard early this year, which includes representatives from Standard Oil Company (N. J.), parent company of Esso Standard, and other affiliated companies. Mr. Hope is serving as temporary chairman of this committee.



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Accidents

Accident Analysis and Impact Studies. HRB-Bulletin 142. 50p. 1957. $11.00. Highway Research Board, 2101 Constitution Ave., Washington 25, D. C.

(Automotive Collision Impact Phenomena, A. L. Hayes and others. p. 1-10.

A Preliminary Study of Speed as Related to Injury Producing Automobile Accidents. John O. Moore. p. 11-18.

Factors Related to Traffic Death Rates. Earl Allgaier and Sam Yaksich. p. 19-28.

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Accident Rates. R. J. Sneed. *International Road Safety and Traffic Review*, p. 25-30, Winter, 1957.

(Relating to some specific conditions, curves and hills, street lighting, night driving. Also questions the use of accident rates per vehicle-kilometer. International Study Work in Traffic Engineering, Stressa, Italy, Oct. 1956)

Fatalities on California Freeways—1955. G. M. Webb. *Traffic Engineering*, p. 294-295+, March, 1957.

Head-On Collisions. Summary. Henry Such Smith. 13p. 1957. Henry Such Smith, 233 Broadway, New York 7, N. Y.

(The need for barrier guards for undivided highway)

Research on Injuries Sustained in Road Accidents. H. J. H. Starks. 13p., 1956, 36c. Road Research Laboratory, Harmondsworth, Middlesex, England or British Information Service, 45 Rockefeller Plaza, New York 20, N. Y.

(Report on crash injury research in U. S. and Britain)

Studying the Danger Spots in Traffic. Public Safety Memo No. 61. 6p., 1957 revision, 20c. National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

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Automobile Seat Belts. *Consumer's Research Bulletin*, p. 23-27, March, 1957.

(Disadvantages of seat belts)

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Average Merit Level for Over-The-Road Driver Personnel. Safety Research. A study in Safety Compliance Ratings. A. F. Mayerhofer. 11p., 1957. Mid-State Freight Lines, Inc., 5200 S. Pulaski Road, Chicago 32, Ill.

(A company's study and recommendations for improving performance of commercial vehicle drivers)

Now the Mail Must Go Through Safely. *Commercial Car Journal*, p. 82-83+, March, 1957.

(Post Office Safety Program)

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(Information from the National Highway Users Conference for buses, trucks and trailers.)

Turn-Signal Laws. *Fleet Owner*, p. 109-121, March, 1957.

(Summary of current rulings by the National Highway Users Conference for autos, buses, trucks and trailers)

State Laws on Safety Equipment. *Fleet Owner*, p. 83-106, March, 1957.

(Digest prepared by the National Highway Users Conference of each state's requirement for buses, trucks and trailers.)

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Management Survey for the Department of Motor Vehicles—Mechanization of Driver Licensing. Survey 745. Department of Motor Vehicles, 2570 24th St., Sacramento, Calif.

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(A guide for adult drivers. Gives information on personal fitness to driver of the car and its parts, driving skills for various conditions and techniques for expressway driving.)

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(Report presented at International Study Week in Traffic Engineering, Stressa, Italy, Oct. 1956.)

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Highway Engineer Has Not Always

Lagged. Richard A. Haber. *Better Roads*, p. 56-60, March, 1957.

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Designing Safety into Our Highways. Louis W. Prentiss. *Street and Highway Lighting*, p. 15-17, March, 1957.

(Importance of lighting in making highways safe at night.)

Factors Affecting the Capacity of Roads. H. Hondermarq. *International Road Safety and Traffic Review*, p. 45-52+, Winter, 1957.

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(Wide medians, use of barriers help to prevent head-on collisions.)

A New Era in Highways. John A. Volpe. *Virginia Highway Bulletin*, p. 1-4, Feb., 1957.

(Traffic and economic benefits from the Federal-Aid Highway Act.)

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Texas' Vehicle Inspection Program. George W. Busby. *AAMVA Bulletin*, p. 1-2, March, 1957.

Vehicle-Inspection Requirements. *Fleet Owner*, p. 125-128, March, 1957.

(Based on information from the National Highway Users Conference. What states and cities, type, frequency, cost, etc.)

Intersections

Accuracy of the Volume-Density Method of Measuring Travel Time. David Solomon. *Traffic Engineering*, p. 261-288+.

(Measuring travel time at approaches to intersections.)

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(Includes accident statistics on before and after lighting installations.)

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The Vital Factor of Visibility in Traffic Safety. Herbert A. Friede. *Street and Highway Lighting*, p. 6-9+, March, 1957.

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The Economic Toll of Night Accidents—The Bill For Our Traffic Ill. Paul Blaisdell. *Street and Highway Lighting*, p. 13-15, March, 1957.

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Pre-Lining for Better Street Marking. Edwin F. Colby. *Traffic Engineering*, p. 270, March, 1957.

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Motor Vehicle Accidents. *Journal of The American Medical Association*, p. 1149-1150, March 30, 1957.

(A progress report of AMA-Committee on Medical Aspects of Automobile Injuries and Deaths—on what doctors are doing in this field.)

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Public Support for Traffic Safety. Harlow H. Curtice, 5p., 1957. President's Committee for Traffic Safety, General Services Bldg., Washington 25, D. C.

(Talk presented at Advisory Council Luncheon, Jan. 18, 1957.)

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A Report on Policies, Warrants and Methods of Analysis for School Crossing Protection. Robert D. Dier. 8p. and charts, 1957. Institute of Traffic Engineers, 2029 K St., N. W., Washington 6, D. C.

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New Master Control System for Downtown Cleveland. Robert J. Kelly, and Thomas Connelly. *Street Engineering*, p. 12-14, March, 1957.

Modification of Fixed Time Signal Controller to Give Semi-Actuated Operation. J. T. Hewton. *Traffic Engineering*, p. 268-271, March, 1957.

Overhead Signs Guide Drivers at Expressway Interchange. Conrad H. Lang. *Better Roads*, p. 38-40, March, 1957.

(Directional signs.)

Simultaneous vs. Tripple Alternate Signal System. John T. Hanna and others. *Traffic Engineering*, p. 263-264+, March, 1957.

(Time and distance studies in Philadelphia under both systems.)

Traffic Control. Marcel Jenni. *International Road Safety and Traffic Review*, p. 33-44, Winter, 1957.

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(Speed situation controversy relative to accidents, opinions of state officials.)

State Departments

Crash or Control. *Citizens Union Searchlight*, p. 1-7, March, 1957.

TRADE PUBLICATIONS

There is a wealth of valuable and interesting information in the catalogs and publications listed below. They form splendid additions to your reference library, affording an opportunity to keep abreast of safety equipment. The coupon below will bring FREE to those responsible for the recommendation or purchase of equipment any or all of the catalogs listed.

1. Police Supplies: Catalog No. 153 illustrates and describes company's line of police supplies. Shown are: sirens, flasher lights, badges, official decals for police cars, fire extinguishers, traffic batons, uniforms, first aid kits, stretchers, traffic signs and hundreds of other items. Specifications and prices included. *W. S. Darley & Co.*

2. Signaling Equipment: A new 56-page catalog illustrates audible signals, hold-up and burglar alarms, horns and sirens, etc. Descriptive data, specifications, prices included. *Auth Electric Co., Inc.*

3. Traffic Signs: Featured in this two-color bulletin are traffic signs, street name signs and reflective marking materials. A reflective coating kit for reflectorizing new or old traffic signs is also described. *Cataphote Corp.*

4. Overload Detectors: Folder illustrates and describes how company's new Overload Detector, Model OD-2 makes it possible for officers charged with enforcing axle load laws to detect overloaded axles while trucks are moving down the highway. *Revere Corp. of America.*

5. Traffiguide Plastic Markers: Four-page folder describes reflecting plastic traffic markers for highways, intersections, parking lots, etc. According to manufacturer the marker utilizes a long lasting material that reflects the slightest ray of light in the dark, marking danger spots on the highway and crosswalks. *Columbia Basin Plastics Co.*

6. Automotive Lighting Equipment: Signal lamps, dome lights, fire department lamps, flashers, switches, signal sets, pilots, pigtails, socket converter kits and plugs are all fully described and illustrated in this 32-page color Catalog No. 560. *Signal-Stat.*

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Washington 6, D. C.

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A. Perrin
173 W. Madison St.
Chicago, Ill.

Citizens Union Search Light
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5 Beekman St.
New York 38, N. Y.

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Washington 6, D. C.

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The *Research Review* is a quarterly supplement published by *TRAFFIC SAFETY* for the complete reporting of research related to traffic safety. The National Safety Council and *TRAFFIC SAFETY* offer this service to those researchers, technicians, etc. in the field because there is no similar outlet for publication of their findings.

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ANALYTICAL AND MATHEMATICAL STUDIES OF ACCIDENT CAUSATION

I—The Application of Quality Control to the Analysis of Accident Data

By Sebastian B. Littauer

Dunlap and Associates, Inc., and Columbia University

This study was sponsored by the Commission on Accidental Trauma of the Armed Forces Epidemiological Board and supported by the Office of the Surgeon General, Department of the Army. The opinions contained herein are those of the author and do not necessarily represent those of the sponsoring agencies or the Department of Defense.

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Introduction

Human injury and property loss resulting from accidents are signs of inefficient operation. A principal objective of this investigation is to reduce the incidence of accidents. Another objective is to increase our knowledge of the causes of accidents. The method of statistical control (also called quality control) has been shown to be an effective tool in the analysis of causes in physical operations. It provides simple techniques for alerting one to the *presence* of unusual causes of variation in a process or experiment. This investigation undertakes to develop the use of statistical control techniques in the analysis of accident causation.

The material in this report should provide safety directors with basic information for undertaking a program for statistical control of accidents.

The Theory of Statistical Control

Perhaps the principal problem in looking for the causes of accidents arises from the fact that accidents rarely result from a single cause. When an accident has occurred, it is almost impossible to describe completely the situation *immediately* preceding the accident to differentiate it from the non-accident situation. We are therefore led to believe that accidents must result from a combination of a great many causes which vary from moment to moment but which, at some particular moment, combine in such a way that this "unexpected" event called an accident occurs. One can rarely isolate individual causes of accidents and associate a particular cause with a particular accident. For example, let us say that the usual stress on a high-speed, rotating part is variable and of a magnitude that will not normally break the part. The variability of the stress may be so great that, on rare occasions, the stress is sufficient to break the part. The breaking may be considered to be an accident, whether or not this event results in an injury. It may be both the cause of bodily injury and of an accidental occurrence whose cause it is desired to trace. One of our problems, therefore, is to detect the likelihood of excessive variation in some physical characteristic of the operation so that corrective action may be taken to prevent such occurrence as machine breakage and consequent injury to workers.

The second difficult problem in looking for the causes of accidents may be exemplified in a situation where an individual feeds material to a machine in which it is transformed and then withdraws it. The movements of the individual are quite variable however steady they appear to be. On occasion, the variability in the individual's behavior as well as in the material and in the machine's motions are such that the individual may be caught in some "unexpected" situation. This unexpected situation need not be described in detail but suffice it to say that he may experience some kind of bodily damage. The important point to recognize is that the occurrence of the accident is due to variability which cannot be readily predicted. This implies that the study of accident frequency must, in its very nature, be statistical. It naturally follows that one must be able to observe many accidents, if one is to be able to trace causes and come to any kind of corrective action. The frequency of accident occurrence in most industries is low in absolute terms. In factories employing about a thousand people there may be an average of no more than one or two accidents during a normal forty-hour work week. Since the time rate of occurrence of accidents is low, it is difficult to apply sensitive statistical analyses to these data. It is self defeating to await information collected over a long period of time for two reasons: 1) The desired criteria are not sharpened by combining data over a long time interval and 2) quick action is desired in order to reduce accidents. We must look for a kind of continuous monitoring which can give us clues to the presence of causes of accident occurrence and to indicated corrective action.

"Should we leave the answer to judgment alone?"

The Analogy Between Statistical Control of Accidents and of Quality

Let us suppose that we are observing the output of a manufacturing process. We inspect each piece produced and designate it as either good or bad in accordance with whether or not the piece satisfies its specifications. In a day's production of say a thousand pieces, we may find twenty bad pieces. Obviously we will not find the same number or the same percentage of bad pieces each day. What percentage should we consider to be an unusually high percentage of bad pieces for any one day? Should we leave the answer to this question to judgment alone? Experience has shown that where the average number of defective pieces produced per day equals twenty per thousand, it is entirely possible that one can obtain thirty-five defectives on some days, and as few as five defectives on other days. Hence we need some criterion to support our judgment as to when to take action on a process because we believe that too many bad pieces are being made.

The making of a bad piece may be compared to the occurrence of an accident. For the occurrence of a bad piece is rather infrequent although, on occasion, many bad pieces may be made. On the other hand, some people believe that the occurrence of an accident is entirely unexpected. Nevertheless there may be a great many accidents occurring in a given week or in a given number of man hours of work.

Returning to the problem of the occurrence of bad pieces in a production process, the question with which we are concerned is how to tell when it is necessary to do something about the process so that the incidence of bad pieces will not rise or that, preferably, it will be reduced to an economically optimum level. Extensive experience, as well as much thought, has led to the strong conviction that a stable state of production over a reasonably long period of time can be attained. This state may be characterized in part by the percentage of defective pieces produced. (It is convenient to put the emphasis on defective pieces rather than on good pieces because the percentage of defective pieces is usually small and more readily manipulated in statistical calculations.) The state of stability, or statistical control, may be characterized in part by the fact that the variation of the daily percentages of defective pieces falls between two limits which are determined in a very definite manner.

In any process of manufacture there are many causes which contribute to the making of good or bad pieces. We cannot in general isolate the individual cause of a particular bad piece from among the many causes which contribute to the end result of the manufacturing process. We do find, however, that, under such circumstances the percentage of defective pieces produced is distributed closely in accordance with the well-known Poisson distribution. If the process remains in a state of control over, say, thirty days we find in general that the average number of defectives for the three successive ten-day periods are rather consistent with one another. We also find that the percentage of defectives from day to day falls within calculable limits. We cannot tell why a particular bad piece was made, or when the next bad piece will be made, but we can tell that on the average we will make a certain percentage of bad pieces by the end of the period of observation.

Suppose that a process of this kind had been in operation for thirty work days, during which it was in statsitical control with an average of 20 defectives from a daily output of 1000 pieces, i.e., a two per cent rate of defective items. Our experience has shown us that we can have a strong conviction that the process will continue in this state and at the same 2 per cent level of defectives.

Suppose, now, that we have this situation:

Day	*No. of Defectives*
Monday	27
Tuesday	26
Wednesday	32
Thursday	40

An alert quality-control engineer would not have become concerned on Monday or Tuesday, but on Wednesday he would have taken note as to what was happening. He would look for some unusual circumstances that might have led to the high number of defectives produced on Wednesday. On Thursday, however, he certainly would have become alarmed and started a search for assignable causes of variation. The thinking involved is merely this: If this process had been truly averaging at 20 defectives a day it was very unlikely that as many as 35 or more defectives should have been produced. In more precise terms one might say that if the number of defective items produced per day (under a constant 1000-piece output) follows a Poisson distribution with a daily mean value of 20 defectives. then the probability of producing 35 or more defectives is 0.001489; that is, it occurs only about 1.5 times in 1000 working days.

We can interpret an event of this sort in one of two ways: we can say we have just been confronted with a very rare occurrence in view of the fact that the daily number of defectives has averaged twenty. Or, we may say that such a very rare event is the result of some particular combination of identifiable causes rather than as merely a rare chance occurrence resulting from a constant system of unidentifiable causes of variation. Then the relative frequency of occurrence of defective parts can give us a signal as to when to look for assignable causes of the variations in the per cent of defectives that occur. These signals alert us to the presence of causes which may be slowly developing or which may have appeared suddenly, and enable us thereby the sooner to find them and to take measures to eliminate them.

No operating system remains in a state of absolute statistical control for very long. Hence it is necessary to monitor any operating system to detect the presence of new causes of excessive variation. The Shewhart concept of statistical control provides us with economical means for becoming alerted to the need for corrective action. The Shewhart control chart concept and associated statistical techniques used in the control of the quality of manufactured product has long been used effectively in cutting down costs of manufacture and in reducing the percentage of unsatisfactory work produced. The principles underlying the application of statistical quality control are general and apply to any kind of observable events.

"Choice of K depends on the purpose of the chart"

A sequence of observable events results from a system of causes; this system of causes may be comprised only of many little indistinguishable causes which combine into a stable system of causes (usually called a constant chance cause system); more frequently, however, the cause system is made up of a combination of chance causes and one or more outstanding causes which endure for varying periods of time. The events resulting from a constant chance system vary in a statistically predictable manner, and there are many simple techniques available for calculating the range of variation, measured frequently as a rate for defective parts.

Criteria for Detecting the Presence of Assignable Causes of Variation

For purposes of illustration we have used the number of defective parts produced and have assumed, for simplicity, that 1000 items are produced each day. Let us suppose that we are producing relays. In Table 1 are given the number of defectives observed in each of 20 successive days of production. Each relay was tested for the "time in milliseconds required to open after application of a given signal." The relays are classified as defective if they do not open in seven milliseconds. Following is the notation used:

n_i, total number of items in i^{th} sample

c_i, number of defective items in i^{th} sample

$\bar{c}$, average number of defectives per sample

$\bar{c} = \frac{c_1 + c_2 + \ldots + c_{20}}{20}$ (Since $n_i = 1000$ for each sample this simplified formula for $\bar{c}$ is permissible.)

σ, standard deviation of the variable (called sigma)

$\sigma = \sqrt{\bar{c}}$

U.C.L., Upper control limit

$= \bar{c} + k\sqrt{\bar{c}}$, where k is some positive constant

L.C.L., Lower control limit,

$= \bar{c} - k\sqrt{\bar{c}}$ (It is customary, but not universal to use symmetrical control limits.)

It is customary in industrial practice to use 3-sigma control limits, that is, to let $k = 3$. The choice of k must in reality depend on the purpose to which the control chart is put and experience with the phenomena to be controlled. Action is called for when observed values fall outside the interval enclosed by the control limits; under these circumstances one concludes that there has been a change in the cause system affecting the variation in the phenomena and searches for the disturbing cause or causes.

In Figure 1 we see a control chart of a process in excellent control. Note that nine points are above the mean, while eleven are below, a reasonably even split among twenty observations. No points lie outside the control limits, although one value, 33, is edging close to the upper control limit. It should be noted that 3-sigma control limits are being used here and that even in such an apparently stable process, one sample mean is close to the upper control limit. The presence of this one high point, of itself, need not cause alarm. This point is here emphasized because experience with accident phenomena suggests that 3-sigma control limits may be too wide to be helpful in signalling the presence of discoverable causes of increased accident incidence.

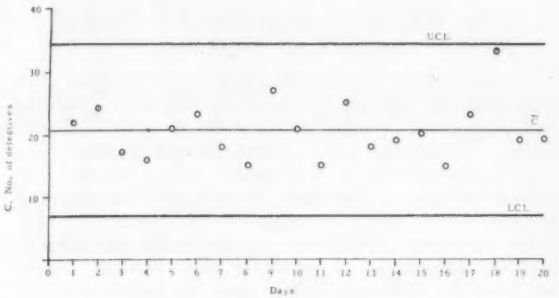

Figure 1. The number of defectives produced on 20 consecutive days; daily production = 1000.

Another criterion that can be used effectively is based on the number of successive observations either above or below the mean or median value for a given sequence. Note that in Figure 1 there is no sequence of five points

Table 1

Daily number of defective relays.
Daily production is 1000 relays.

Group No.	*No. of Defectives, c_i*
1	22
2	24
3	17
4	16
5	21
6	23
7	18
8	15
9	27
10	21
11	15
12	25
13	18
14	19
15	20
16	15
17	23
18	33
19	19
20	19
$\Sigma c_i =$	410

$\bar{c} = \frac{410}{20} = 20.5$

$\sigma^2 = \frac{\Sigma c_i^2 - \bar{c}^2}{n(n-1)} = 22.036$

$\sigma^2 = \bar{c}$ (for a Poisson distribution)

$= 20.5$

$\sigma = 4.69$

U.C.L. $= 20.5 + 3(4.69) = 36.1$

L.C.L. $= 20.5 + 3(4.69) = 4.9$

"Use of statistical criteria, insight leads to decisions"

in succession which lie either above or below the mean value. There are, however, four successive points below the mean. The probability of a run of four above the mean (that is, the true mean) among four successive points is $(\frac{1}{2})^4 = \frac{1}{16} = 0.0625$.

Since there is an equal probability for runs below the mean as for runs above (assuming symmetry of the distribution,) the probability of a run of four above or below the mean is 0.125. This is not a rare event. For that matter, a run of five or more on one side of the central line is not a rare event. A rule of thumb is to look for assignable causes when a run of seven (a probability of 0.015625) above or below the control line appears. In the writers' experience in industrial production, however, a run of five invites caution. For accident phenomena a run of five values above the mean may be worth looking into.

Check the Trend

A third criterion that we can use effectively is the evidence of an upward or a downward trend. In Figure 1 there are no such trends which need alert us to corrective action. The trend is not a very quick indicator, yet it may give indication in time to avoid serious results. The nature of accident phenomena is such that the trend indicator may be quite useful.

Still another criterion that is useful on occasion is the existence of runs up or down. A run up is a succession of two or more observations in which each observation after the first is higher than its predecessor. In Figure 1, we have some runs (up or down) of two and some runs of three, but we have no runs of four. In a stable Poisson distribution runs of 2 or 3 are reasonably common. Runs up of 4 are not common, but runs up of 5 are so uncommon that they should be suspected of indicating a change in the cause system. Similarly, of course, for runs down, although the indication may be of a desirable causal change rather than of an undesirable one. We must, however, be alerted to desirable unusual events, for they may lead to action which will enable us to make desirable results more permanent.

We are not limited to these four criteria in our analysis of our data. Any of the familiar statistical tests may be used, and in particular, we will have occasion to use the well-known Student's "t" test. Analysis of such data, and in particular the search for causes of unusual variation are not dependent alone on statistical inference but on the application of judgment and the insightful application of previous experience. Furthermore, it should be noted that the effective use of statistical control techniques does not result from the "one shot" use of statistical inference but on the continuing amassing both of data and of indications of causes of variation. The use of these techniques in turn leads to the development of a firm conviction about the necessity for corrective action, given action signals, and ultimately to a state of predictiveness. Through the continued monitoring of observations and of the results of corrective action, it is possible to acquire a deeper insight into the behavior of the operation, into the causes which influence the operation and into the ways of searching for troubles that are to be eliminated.

With the aid of various statistical criteria this insight leads to decisions, the results of which are likely to be in conformity with one's expectations as regards the presence of changes in the casual system. In the use of statistical control methods one is subject to two types of error in decision making. This is because at any one time there exists two alternative decisions:

1. Examine the operation or process for the presence of undesirable causes, or
2. Let the process or operation continue without any intervention.

Our action criteria, must be so chosen that there is a balance between the advantages we gain by the use of these criteria and the losses we experience by the so-called misguidance of these criteria. There can be no golden rule for the establishment of these criteria so as to give an economical balance, nor can there be purely probabilistic rules which assure minimization of error. All that can be said is that under certain given conditions there is a certain probability of erroneous decision of either kind. In most practical situations a formal calculation of the cost of errors of decision is almost impossible to make. Nevertheless, in any continuing operation, experience over sufficient time leads one to practically satisfactory criteria.

In the economic control of the quality of manufactured products, satisfactory results have been achieved by using the so-called 3σ control limits; that is to say, control limits equal to the grand average $\pm 3\sigma$. It need not follow that these control limits are the most fruitful ones that can be used in the discovery of assignable causes of accidents. It will take considerable experience in the use of these techniques to arrive at satisfactory control limits for accidents. Examination of the data collected so far, however, has indicated that it is advisable to try 2σ control limits. It is true that in using 2σ control limits, even were there no change in the frequency of accident occurrence, one would get observations above the U.C.L. or below the L.C.L. in about five per cent of the cases. Looking for assignable causes of accident occurrence when none are present may lead to disappointment and relaxed vigilance. It must be borne in mind, however, that the control of accident phenomena and the development of good safety procedures is a continuing function and good safety practice is not inconsistent with, let us say, excessive alertness to the possible presence of assignable causes of accident occurrence, provided that this practice is not too costly. On the other hand, if one were to wait for such signals as might occur only, say, about one time in three hundred by chance, one might miss many opportunities for early application of corrective action and good safety practice which in the long run bring results, although it may not immediately turn up specific causes of accidents.

Statistical control methods cannot effectively be used in mere routine fashion. These methods must be supported by intuition, insight, judgment and experience. The present studies are expected to show how statistical control methods can support the good judgment and experience of safety directors. It is hoped that these studies will also show how practical accident reduction can be encouraged by their use. It is therefore important to look upon the analyses of these data as providing the basis for a well-designed and well-

Two dozen items of information needed . . .

planned pilot study for the future rather than for the specific results which these analyses and interpretation of themselves provide. References

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Analytical and Mathematical Studies of Accident Causation

II—The Application of Statistical Control Methods for the Reduction and Control of Industrial Accidents

By Sebastian B. Littauer, Dunlap and Associates, Inc., 429 Atlantic St., Stamford, Conn., and Columbia University and Thomas S. Irby, Dunlap and Associates

1955

This study was sponsored by the Commission on Accidental Trauma of the Armed Forces Epidemiological Board and supported by the Office of the Surgeon General, Department of the Army. The opinions contained herein are those of the author and do not necessarily represent those of the sponsoring agencies or the Department of Defense.

I. INTRODUCTION

The principles of statistical control methodology and their application to the analysis of accident experience have been described in Part I. This report deals with the application of these principles to the study of actual accident experience in four industrial establishments. The results are presented separately for each.

A. *Purpose*

The over-all objective of this study was to determine the effectiveness of statistical control methods in the analysis and control of industrial accidents. The specific objectives were:

1. To determine if the methods discriminate between periods of stable and unstable accident frequencies, by examination and analysis of past data.
2. To determine if the methods provide safety directors with signals indicating the presence of identifiable causes of accident occurrence on a current basis.
3. To search for assignable causes when their presence is indicated and to attempt their removal.[1]

B. *Procedures*

1. *Selection of Participating Organizations*
The two major factors in the selection of study sites were: (1), consent of the management; and (2), the geographic location of the company. Manufacturing establishments in both urban and rural centers were chosen. The products manufactured included: electrical products, household products, optical goods and office machinery. It was intended that the range of hazards be sufficiently broad so that any conclusions reached would be of general interest and applicability.

2. *Selection and Collection of Data*

Because the value to be derived from the analysis of accident experience rests firmly on the data, considerable effort was expended to insure that the most complete data available were used and that the limitations of these data were known. One major problem concerns the uniformity of the data: each industrial establishment exhibits at least minor differences in reporting procedures as compared with other companies. Consequently, reporting procedures were examined in great detail to insure comparability between organizations.

The data were obtained from medical office records and from injury reports prepared by supervisors. The category of injuries included in these reports are the "reportable" or "lost time" variety wherein the man injured cannot complete his working day or cannot return for the next day's work. (There are minor differences in definition of this category from plant to plant.) *Some "first aid,"* or minor injury, data were available and were also analyzed.

Preliminary investigation suggested that a comprehensive analysis of accident experience should, if it is to isolate causal factors, have access to at least the following items of information associated with each accident:

date	job description
time of day	nature of injury
shift	human acts involved
number of shifts	mechanical failures
case number	amount of lost time
sex of injured party	location of accident
marital status	number of previous accidents to the injured
age	number of employees by sex
length of service in company	number of man hours daily
length of service on job	number of days in work week
number of employees on each shift	number of lost time cases in period
per cent of overtime	number of first aid cases in period

Omission of any of the above items weakens the pos-

[1]This last phase was not as intense as originally planned. The intimate participation by key company administrators was not available in the amount necessary due to the press of other duties.

Investigators tried two sigma control limits . . .

sibility of constructive action and control. In most organizations, much of this information is not available and therefore the influence of some hypothesized factors on accident frequency cannot be tested. For example, the most difficult item to obtain was an accurate man-hour breakdown for the days, shifts, etc. These difficulties emphasize the need for more uniformity in data collection procedures and collection of more pertinent data.

3. *Processing of Data*

Statistical control methods are directed at systematic analysis of the causes of observed variation in the phenomena studied. The control chart has been the principal tool used to isolate, timewise, the introduction of such sources of variation. In this research, this technique has also been used and the use of non-formal correlation and non-analytic examination of histograms have also played a fruitful role. The accident rate defined as the number of accidents per million man hours, has been the principal variable under study.

In general, accidents are indexed to the time of occurrence. The exceptions to this practice present some difficulty. For example, in some cases the accident report is not filed until an investigation is completed, which may be as much as several months after the occurrence of the mishap. Care was taken to assure that all accidents were indexed to the time of occurrence and that all accidents were recorded at the time of analysis.

In control chart analysis, accident rates are considered for successive time periods. It is desirable that the man hours of exposure be constant for the time periods. However, it is difficult to obtain a breakdown of man hours so as to determine successive units of elapsed time during which a constant number of man hours have been worked. Hence the most practical way in which to determine accident rates for control chart analysis is to obtain them for successive weekly, bi-weekly, and monthly periods. In addition, rates were calculated for such subcategories of workers as were available in an effort to find the influence of specific factors on accident incidence.

II. ANALYSIS AND RESULTS

In the use of statistical control procedures for the control of quality of manufactured product, three sigma control limits are used as action signals. Using these same limits for the accident data, it was found that although there were indications in the data of the presence of assignable causes, only rarely did points on the control chart fall outside the control limits. By subsequent investigation in several cases, the investigators were able to tie some of the "in control" fluctuations in the accident rate to known causes. In addition, as one narrows the control limits, the control chart becomes more sensitive in the sense that it will detect smaller real changes in the accident rate albeit at a larger risk of error of detection. These facts led the investigators to try two sigma control limits in the belief that they would provide action signals more often when assignable causes are present. The most useful control limits may vary with the situation; it appears at this time that this is a factor which must be determined by the cognizant safety personnel in each situation.

CASE STUDY A: ANALYSIS OF THE ACCIDENT EXPERIENCE OF THE ELECTRIC PRODUCTS COMPANY

1. *Company background*

This Company had been manufacturing a complex electrical product for some five years. The Company had had an active engineering and manufacturing development program. Since the product is relatively new and the field highly competitive, it is to be expected that the Company may have been undergoing dynamic change and adjustment. Developments of both an engineering and a production nature are being actively prosecuted all the time. Under these circumstances it may be expected that there will be marked fluctuations in production processes and assembly-line layout and in other of the technical aspects of the Company's operation.

There have also been numerous problems of equipment, training and replacement of the labor force. In addition, there has been the serious problem of developing an effective permanent supervisory staff. This Company provides an example of a very dynamic manufacturing atmosphere in which the problem of safety control presents many challenging problems.

For a number of years now, under the authority of the Personnel Director, there has been a full-time safety engineer whose function has been to develop and maintain effective safety practices. In this company's manufacturing changes, where there have been many engineering and manufacturing changes, stabilizing safety practices has been a great challenge.

Hence it might be expected that the accident and injury experience of this Company provides a good proving ground for the present analysis. The policy of this Company is to have every injury, however slight, reported immediately to the foreman and then to the medical office.

2. *Control Chart Analysis*

Figure I shows the control chart for monthly accident rates from January 1952 through December 1954. It is customary practice to establish initial control limits on the basis of at least twenty data points. It is clear however, that if this were done, too great a portion of the data would be included.

In addition, examination of the data without regard to control limits indicates that two different sets of rates exist.

Consequently, the period from January to October 1952 was considered to be the initial period. The mean rate (number of accidents per million man hours) is 48.7 and the upper and lower control limits are, respectively, 78.3 and 19.1.

All ten points lie within the established control limits.

If these control limits were extended into the future, the next data point, November 1952, would lie far outside the limits. Thus a signal would have been provided that there existed a possible assignable cause for the marked increase in rate.

During the first period of control there are indications that there was a definite upward trend in the rate. The first four month's rates are all below the mean whereas

Control charts furnish signals for corrective action

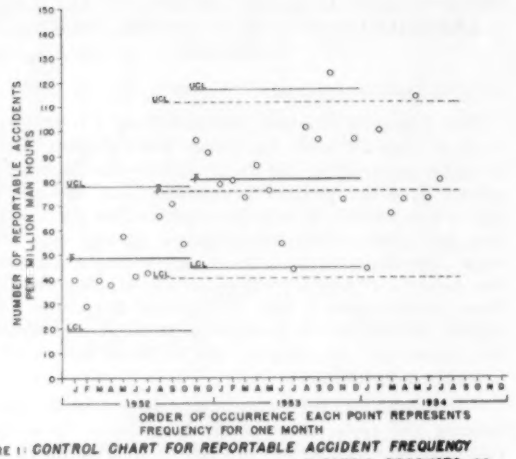


FIGURE 1: *CONTROL CHART FOR REPORTABLE ACCIDENT FREQUENCY -ELECTRIC PRODUCTS CO.*

four of the last six months are above the mean. The fact that the next two points lie above the upper control limit emphasizes this trend.

The practical significance of the trend becomes even more important when the next 14 points are considered (November 1952-December 1953).

A year after these indications, the safety director indicated two general causes were probably in action, process changes, and increase and turnover in the labor force.

The causal influences were apparently continuing, for during the next 14 months, 12 of the rates fell above the mean for the first period.

The fact that many of those 14 points fell within the control limits for the first period highlights the control concept that an individual datum cannot be considered in isolation, but must be studied in light of the immediately past data.

During this period, there was one point below the lower control limit (July 1953) and one point above the upper control limit (October 1953).

The low point falls in a month when production is usually low and when the plant closes down for a two week vacation.

The high point indicates instability in this period and in fact, is a warning of the periods to come.

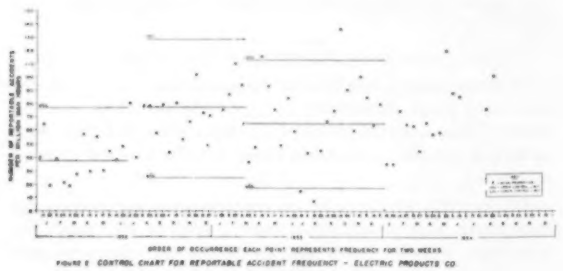


Figure 2 is a control chart for bi-weekly rates based on the same accident experience as Figure I. The gain over the monthly chart appears to be substantial.

The bi-weekly rates through the interval July 12, 1952 to March 8, 1953 are all above the mean level for the preceding period. Both of these periods show definite upward trends.

Thus, earlier and more frequent signals for corrective action are provided by the bi-weekly control chart than are provided by the monthly chart. There is substantial agreement between the interpretation to be derived from both charts, but the bi-weekly chart provides signals more quickly and more frequently.

Examination of Figure 2 reveals a marked upward trend beginning in the middle of August 1953 and continuing through October of the same year. Then, from November through April 1954 the rates show a decrease; shortly thereafter the rate again rises and is maintained at a higher level throughout 1954.

A search for causes *during* the period of decrease might have indicated some factors which yield a lower rate.

There is one disadvantage, in the use of rates based on the shorter time interval. Since the width of the control interval is inversely proportional to the number of man hours in the period, the bi-weekly limits are 1.4 times wider than the monthly control limits. This implies that a larger change in rate is necessary with the bi-weekly period in order to provide signals. This loss of sensitivity does not appear to be critical in light of the advantages of the bi-weekly break-down.

May Yield Lower Rate

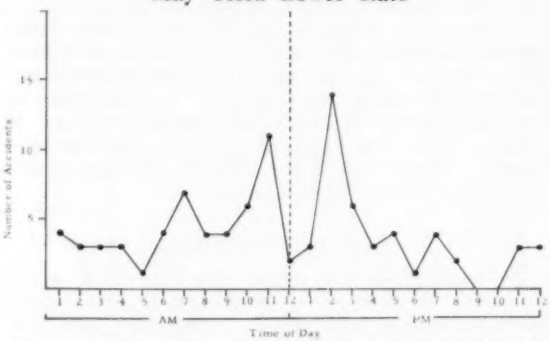


Figure 3. Number of accidents occurring at various times of day. January through July, 1953. Electric Products Co.

A control chart for weekly rates, indicates that although the interpretation of this chart is in essential agreement with those of the bi-weekly and monthly charts, there is too much loss of sensitivity. Since the absolute number of accidents is low and the weekly man hour base is small, the resulting increase in the width of the control interval reduces sensitivity too much to make the weekly control chart more useful than the bi-weekly control chart *in the present case.* It is clear, however, this conclusion is not necessarily valid for all applications, and thus the interval should be studied carefully.

Single out the proper categories for special attention

3. *Isolation of Causes*

Table I shows the accident rates for all employees, male employees and female employees for each week in the period from January through August 2, 1953. During this period the female group suffered only 11 accidents while the male group suffered 115; the male employees put in about three times as many hours as did the female. This gross evidence would indicate that the males account for most of the accident rate. The changes in the rates for the total work force almost paralleled the changes for the male employees only. And, of course, the mean weekly rate for the males is so much higher than that of the females that it can be seen that the females contribute little to the total mean rate.

Therefore, it can be suggested that the safety director focus his attention on the male labor force. This may materially, reduce the amount of effort required, for it is clear that the majority of hazards faced by the male force are quite different from those faced by the females.

Table 2 shows a breakdown for the major part of 1953 of accident occurrence by department and by type of injury. There are 16 injury categories and 20 departments. Five of the departments, Plant maintenance, Units, Salvage, Testing, and Bulb preparation, contributed 71 per cent of the accidents.

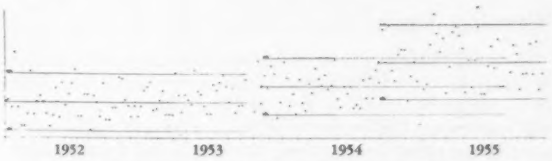
Table I. Weekly accident rates for males, females and total work force, Electric Products Company, January-July, 1953.

Week ending	Total work force	Males	Females
Jan. 11	92	108	53
18	75	106	0
25	75	106	0
Feb. 1	123	124	104
8	51	72	0
15	86	120	0
22	134	188	0
Mar. 1	67	92	0
8	118	162	0
15	0	0	0
22	74	61	108
29	29	41	0
Apr. 5	120	97	0
12	103	74	0
19	179	253	0
26	124	150	61
May 3	65	49	122
10	74	104	0
17	77	82	64
24	43	40	47
31	56	80	0
June 7	77	110	0
14	91	86	52
21	0	0	0
28	119	148	50
July 5	—	—	—
12	0	0	0
19	27	60	0
26	43	62	0
Aug. 2	43	62	0
Mean rate	72	88	25

Eighty-two per cent of the injuries are accounted for by the seven highest of the 16 categories. The highest incidence of these seven categories occurred in the department with the highest incidence, Bulb preparation.

Similarly, other departments and accident categories can be singled out for especial attention. That is, the control chart tells when to look, and the analysis of the accidents themselves indicate where to look.

Further analysis can yield even more information. Figure 4 shows the hourly incidence of accidents during the year 1953.



Order of occurrence each point represents frequency for one week.
Figure 4. Control chart for reportable accident frequency. Household Products Co.

The peaks on this chart are easily definable and lead to hypotheses which may be tested experimentally. For example, if the 2 o'clock peak is due to fatigue, a rest period just before that time should reduce the incidence at that hour.

CASE STUDY B: ANALYSIS OF THE ACCIDENT EXPERIENCE OF THE HOUSEHOLD PRODUCTS CO.

1. Company background.

This company is a division of a large decentralized organization with numerous plants throughout the world. It is subject to the broad over-all policies of the central management but, for the most part, manages its own affairs and acts like an independent company.

This organization produces articles both for consumption on the civilian market and for use by the Department of Defense. Each of these products is not in continual production, but is produced in accordance with a production schedule based on orders, anticipated demand, etc. This company, then is characterized by the diversity of its products and by a frequently changing manufacturing schedule.

The company has been in operation for more than 25 years and its growth until recent years has been described as steady with few major changes in production methodology, products, etc. However, in 1953, several new products were added, employment increased markedly, and the company began a transfer of its operations to a new plant.

This company provides the picture of a steady operation suddenly confronted by a series of changes. How these changes are mirrored in the accident experience is of first importance here.

The control chart for monthly accident rate, the usual method of reporting, showed that two markedly different periods of control existed in 1952 and 1953, the change occurring about April of the latter year. From records kept by the safety staff and from their personal recollections, it was possible to attribute that change to the plant expansion program and the shift of some of the manufacturing activities to a new site.

Specifically, these changes resulted in (1) a large influx of new employees who had a disproportionately large number of accidents, (2) transfer of employees, (3) new prod-

"The signal may warn of a short-lived cause"

ucts, (4) new production quotas and the use of overtime and (5) a new group of foremen who were untrained in safety. Had the control chart been in use at the time, the suspected causes might have been better pinpointed and corrective action could have been taken.

Warning Signs

Another change, toward a higher accident rate, occurred in April of 1954. The control chart shows some indication of a change occurring as early as November of the preceding year, when the monthly accident rate was suspiciously close to the upper control limit. Including that month, there is a run of four data down-wards, offering some indication that the situation should have been examined more closely.

In an effort to investigate the sensitivity of other time periods for the Household Products Company, a weekly control chart was prepared, Figure 4. It was hypothesized that the week to week variation in accident rate might provide earlier indications of the changes. In general, the same periods of stability were indicated however, there is one major difference. The weekly charts give indication of the impending change in the level of control two to three weeks or more before the monthly chart did.

Where the monthly chart signaled a change in April of 1953, the weekly chart showed the indications in the middle of January. Where the monthly chart showed the change in April of 1954, the weekly chart indicated the change in the middle of March. In general, then, the weekly chart does provide earlier indications than does the monthly chart.

In addition, the weekly control chart shows signals obscured by the monthly chart. For example, on the monthly control chart the rate for July 1954 seems to fall well within the control limits.

On the weekly chart, however, the last week falls above the upper control limit, providing an action signal.

Though this signal may not herald a change in the level of control, it may provide warning of a short lived cause which should be avoided in the future.

The weekly control chart in this organization provided more positive indication of a change in one circumstance than did the monthly chart. The data for November 1953 through February 1954 showed a downward trend that represented, at best, a weak signal.

On the weekly control chart, however, a clear indication is seen; the last eight points are all at or below the mean, a phenomena that would happen only once in 256 times by chance alone. The points out of control during 1954 have all been attributed to changes in production pressures, overtime utilization, and the like.

The bi-weekly control chart represents a compromise between the two other methods of data processing. Major changes in the level in the accident rate are clearly shown as on the two preceding charts. As expected, signals for the presence of assignable causes appear sooner and more often than on the monthly chart, more slowly and less often than on the weekly chart.

There are several differences between the three time periods which are worthy of discussion.

On each of the three control charts consider the period April-June 1953. Within this time there occurred two peaks in the accident rate: one in April and one in June. Consider the April peak and its relationship to the limits projected from the previous period of stability.

The monthly chart shows the April rate to be above the upper control limit by a substantial margin; the bi-weekly chart shows a point just barely above the upper limit; and the weekly chart shows no points above the upper limit, but only a cluster of six points all above the mean. The peak for June reverses this order, with the weekly chart showing the clearest indication.

Sensitivity Shown

The kinds of sensitivity of the three charts is illustrated by this difference. The longer the time period chosen, the more likely is the possibility of detecting small changes that last a long time.

As the time period is shortened, the probability of detecting large, short lived changes is greater.

This would indicate that the monthly chart should be used to detect major shifts in accident rate while the weekly chart can be used to detect changes of relatively short duration.

3. Isolation of Causes.

This company had data which allowed the investigators to isolate the departments showing the most accidents and also the kinds of hazards most likely to account for the accident rate.

Table 3 shows body areas injured in the various departments for the year 1954. The three departments with the greatest absolute number of accidents are, in order of magnitude, Nos. 22, 25 and 21.

Together with departments 23 and 29, these departments sustained 47 per cent of the total Reportable No Lost Time injuries in 1954.

Spotting the Hazards

While the accident rates in these departments may not hold the same positions of prominence, these clusters of accidents enable the safety director to direct his attention to those locations in which the cost of injuries is the highest.

Although a departmental man hour breakdown was not available, the investigators learned from the number of employees in each department that these departments do show the highest rates.

Table 3 also provides a beginning of an investigation into the kinds of hazards that produce injuries.

Finger injuries, for example, are most prominent.

From information of this kind, departments with high number of finger injuries can be singled out and their accident records studied more carefully to see if the kinds of injuries occurring are the result of hazards common to the departments.

If so, then a single alleviating action can be taken which will have an effect in more than one department.

First-aid case increases herald rising accident rates

Table 3.

ACCIDENT SUMMARY
DEPARTMENT X BODY AREA INJURED
HOUSEHOLD PRODUCTS CO.

Reportable No Lost Time Accidents*, 1954
Body Area Injured

Dept.	Fingers	Hands	Wrist	Arm	Eye	Foot	Leg	Body	Chest	Back	Face	Head	Total
02	4	2		1	6	1			1				15
03										1			1
04	5						1			1			7
05	6			1	2			1			1		12
07	1	1		1	4					1			8
11					1								1
12			2	1	1		1						5
13					1			1					2
17	12			1	2	1	2	1		6			25
18	22	3	2	3		4		2		3		4	43
19	7	1	2	1	1	2		2		2			18
20	6	2	1	2		1			2				14
21	21		5	12	1	5	2	6	1	6		4	67
22	26		1	6	6	6	10	6		5	4	5	83
23	18		2	11	3	4	2	1	1	4	3	4	59
24	6		1	3	3	3	2			5		1	27
25	18	8	2	7	5	5	4	5		6	4	11	78
26	6	2	1		3			1		2			16
27	3			2									5
28	5			3	2					2		1	13
29	25	7	7	1	1	5	3	6		3	3	3	64
31	4	2	1										7
32	3											1	4
41	3	1			2								6
42							1	1					2
43	7	1		2		2	1			1			14
44		1										1	2
47	5												5
49										1			1
50					1								1
51	1					1							2
52								1		2			3
54							1			1			2
56										1			1
57				1		4	1			1		1	8
58	1	1				1				2			5
60	2				1								3
63				1				1					2
64										2			2
65	1	2								1			4
67	4	1	1	1	1		3	5		2	2		20
68	2	1			1						1		5
70	2		1	1	2							1	7
71	6	3	1	3	3			2	2	3		2	25
72				1									1
73	1		1										2
75						1							1
81	1						1						2
82	2				1								3
89	5						1	1	2	1	1	1	12
93	4			1	1	1							7
94	1			1									2
150										1			1
151	3												3
160						1							1
172										1			1
601						1			1				2
603	2	1			2		1	1		1			8
604	1											1	2
606	1												1
607												1	1
Total	253	60	31	68	57	49	37	44	15	69	19	42	744

*These figures do not include the accidents judged potentially compensable, a full report of which is made each month to the State.

Henrich has reported that a fixed proportionality exists between lost time injuries, reportable injuries, and first aid cases, and reported that he found the ratios to be 1:29:300, respectively. In addition, many safety directors report that their reportable accident rate increases are almost invariably preceded by an increase in first aid cases.

It is desirable, then, to try to develop a "barometer" for these kinds of changes which would provide action signals before the events occurred. An attempt was made to determine whether an increase in reportable injuries was preceded by an increase in first aid cases. The monthly rates for these two kinds of injuries for the year 1954 were studied.

Little or no relationship was found. This period, though, was characterized by a higher and more variable accident rate than the other periods studied. It is possible, then, that the hypothesized relationships exist only during period of more stable accident rate.

It is also possible that were these rates studied on a weekly basis that the hypothesis would be confirmed. All this implies a worth while area of investigation for the safety director.

CASE STUDY C: ANALYSIS OF THE ACCIDENT EXPERIENCE OF A PRECISION OPTICAL PRODUCTS COMPANY

1. Company background.

This old and successful company has had a slow but substantial and solid growth. Its processes and techniques of manufacturing differed from those of the other companies studied in that more individual skills were required.

Considerable emphasis is placed on safety in this organization; it has the lowest rate of all the establishments studied and it has shown a decrease of 50 per cent in the accident rate since 1951.

2. Control Chart Analysis

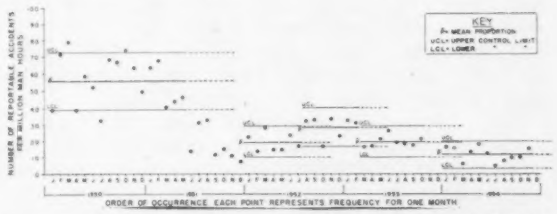


Figure 5. Control chart for reportable accident frequency—Precision Optical Products Co.

Figure 5 shows the control chart for monthly "reportable" injury rates for the years 1950-1953. There are four periods that can be distinguished with respect to statistical control:

1. January 1950-May 1951
2. June 1951-July 1952
3. August 1952-February 1953
4. March 1953-October 1953

The first change is distinct from the remaining three in that the mean injury rate drops sharply from 55 injuries per million man hours to some 20. There seemed to be a consistent development towards a very low level lasting from March through December 1951.

"Lost-time injuries indicate trends in severity rate"

It is noteworthy that all the data from period 2 fall below the lower control limit of period 1.

This change is observable without the criteria of statistical control, but these methods emphasize the change.

The first period is definitely unstable as a number of points outside both control limits indicate. Although it is not possible to discern the exact causes for this, there is some information about this period which indicates, at least, the kind of things which may have been responsible. In July 1950, for example, there was a plant shutdown. In August there was a change in accident reporting procedure which could have resulted in more accidents being reported.

In addition, there was a considerable increase in employment beginning in August and continuing for some time.

Other points on this chart are worthy of interest. In October of 1953 there was a drop in the accident rate, coincident with a new wage policy. In the beginning of 1953 the president of the company announced the corporation's concern with safety and the safety director began an intensive supervisor safety training program.

The accident data were reprocessed on a weekly basis

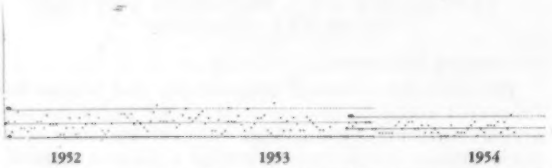


Figure 6: Control chart for reportable accident frequency—order of occurrence. Each point represents frequency for one week. Height—scaled from 0 to 200 shows reportable accidents per million man hours. Precision Optical Products Company

and are presented in Figure 6. It was thought to be unnecessary to consider the years 1950 and 1951 again, consequently the following discussion is concerned with the three year period 1952 through 1954.

Omitting the extremely high rates for two weeks in August 1952, mean and control limits were calculated for the year 1952 and extended through 1953. The mean for 1952 was 21 accidents per million man hours with 43 and I as upper and low control limits respectively. The two high rates were eliminated from the calculation of mean and control limits since the several accidents they represent occurred during a vacation period when man-hours worked was approximately 4 per cent of normal.

This, of course, is a decidedly different accident population and should be omitted in describing the characteristics of the rest of the year.

Examination of the weekly data also reveals four distinct periods identified by statistical control analysis on the monthly chart:

January-July 1952
August 1952-February 1953
March-November 1953
January-December 1954

Because the year 1952 was selected as the basis for calculation of mean and limits, these periods are detected on the monthly chart.

Figure 6 shows the accident rate to be essentially stable, but with a continuous downward trend toward the low level in 1954.

Not so apparent at first glance are the distinct periods referred to above. The periods January-July 1952 and March-November 1953 cannot be differentiated from each other.

However, the intervening period August 1952-February 1953 exhibits a shift upward. On the monthly chart, this period was shown to have a higher mean level with no points outside control limits. The weekly control chart distinguishes this period by showing almost all the accident rates to be above the mean accident rate for 1952, with two points above or on the upper control limit. This is but another example of how the presence of assignable causes may be detected by different criteria of variation:

The fourth period, January-December 1954 is clearly differentiable. Before the end of January 1954, the weekly control chart indicates the accident experience has entered a new phase.

Subsequent data for the rest of the year 1954 indicates that the new low rate of 12 accidents per million man-hours is not just a temporary random change in accident level but is a homogeneous period of stable accident rate, probably brought about by conscious and persistent application of safe working habits among the plant's employees.

3. Isolation of Causes.

Statistical control methods applied to such stable (since late 1951) accident experience as that found at the Precision Optical Products Company may not be as valuable as in other companies where larger absolute numbers of accidents are involved.

Here, when the overall accident rate is small and stable, the occurrence of a point above control limits may be an indication only of some localized problem which has less general, plant-wide importance than in cases where more accidents are involved.

A fruitful source of larger masses of data which relate to accident experience might be the first aid cases.

First aid data were obtained and plotted for one year (1954) on a million-man-hour base, but were found to exhibit no apparent relationships to reportable accidents.

A brief examination of lost time injuries was made to get a general idea of the trend in the severity rate. It was found that the twelve-month cumulative severity rate has decreased steadily from about 0.150 in the latter part of

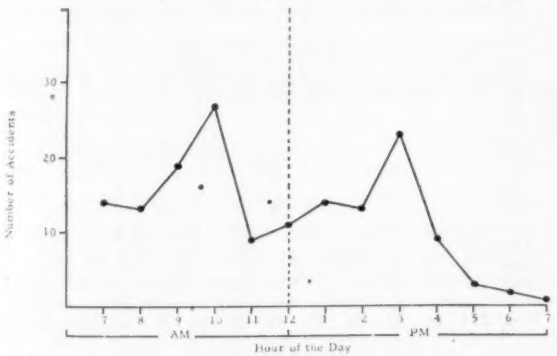


Figure 7. Number of accidents occurring at different hours of the day. 1952—Precision Optical Products Company.

"A bench mark is needed to evaluate rates"

1952 to about 0.050 in August 1954. In general, a change in the injury rate seemed to be accompanied by a change in the severity rate in the same direction.

Histograms showing injury frequency as a function of length of service and age group were limited in intepretability due to lack of total plant population data for this company.

One other brief analysis was made that substantiates results of prior studies by other investigators. Tabulation of the number of accidents occurring at various times of the day may be seen in Figure 7. Peak periods at 10:00 A.M. and at 3:00 P.M. are fairly typical for industrial work. The frequency of accidents in both the morning and afternoon periods gradually increases and then decreases toward the end of the period. An explanation for this phenomenon is suggested by the shape of daily curves of production which show similar peaks. It may be that industrial accidents are a function of the rate of production.

The accident experience of the various departments contributed useful information at this establishment as it did at others.

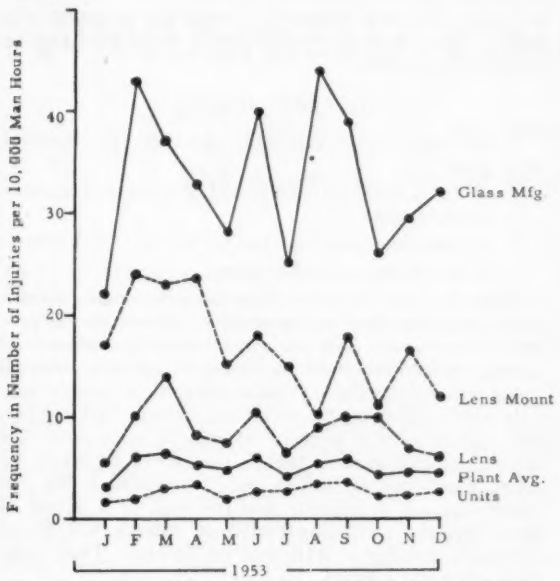


Figure 8. Departmental injury data—Precision Optical Products Company.

Figure 8 shows the frequency of *injuries* in various departments per *ten-thousand*-man-hours worked. (These, then, represent the more costly accidents.) The four departments shown represent the entire range of rates in the company. It is clear that there are quite large differences in these rates and thus they should serve to direct attention at the most serious sources.

CASE STUDY D: ANALYSIS OF THE ACCIDENT EXPERIENCE OF THE OFFICE MACHINERY COMPANY

1. Company background.

This company was organized in 1920. Growth was fairly slow until the 1940's. In the five year period 1947-1952 jobs increased nearly 50 per cent and payrolls rose 81 per

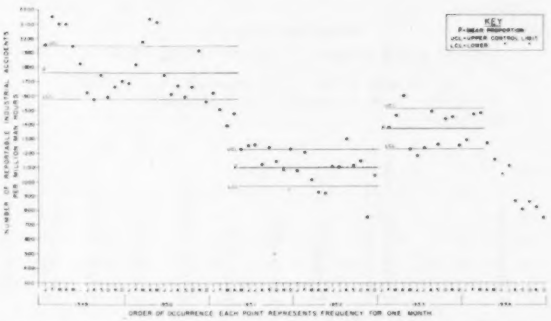


Figure 9. Control chart for reportable industrial accidents—Office Equipment Mfg. Co.

cent. Today the organization has 3500 employees with a modern plant and a large field organization operating in branch sales and service offices. Products include a line of office machines and accessory devices. Usually several models of the principal articles are manufactured. The investigators confined their efforts to the main plant whose employees numbered 1400-1600 during the years 1953 and 1954. The safety staff consists solely of the safety director, although the company has a safety committee which formulates policy and appoints sub-committees to perform much of the work required in the safety effort.

2. Control Chart Analysis.

Access to monthly records enabled the investigators to study the accident experience of this company during the years 1949-1954, although the analysis was not begun until 1954. Figure 9 shows the six years of data during which time several distinct levels and major changes in the injury rate are apparent. The years 1949 and 1950 are characterized by marked instability. It was during this time that employment was increasing.

Two peak periods, February-March and April 1949, and April-May 1950 are each followed respectively by two marked decreases in accident rate, which suggests a seasonal variation owing to production pushes. The entire two year period, 1949-1950 was considered as a unity in order to establish a bench mark from which to evaluate the ensuing accident rate. The mean rate of 1760 seems very high; however, this figure includes all categories of injuries plus many injuries suffered outside of working hours. This kind of data collection may yield signals of assignable causes, but it does not yield the degree of localization desirable for identifying these causes.

It was not possible to get information about the changes in rate prior to the middle of 1953, the time when the present safety director took office. Consequently, these data cannot be discussed in detail.

The eight month period from August 1953 through May 1954 was stable, after which there began a steady downward trend for the remainder of 1954. Conferences with the safety director disclosed several important events which together, may have contributed to these phenomena:

1. New Safety director developed and proposed new improved safety program in July and August 1953.
2. Night shifts ended in February 1954.
3. New insurance carrier in April 1954, followed by formation of a new safety committee.

"Any new causal agent would probably be detected"

Table 4.

Office Machinery Co.
INDUSTRIAL INJURY ANALYSIS
12 months (Nov. 1953 through Oct. 1954)
(Eye injuries not included)

Department		Laceration, Abrasion, Avulsion, Puncture	Foreign Bodies	Contusion	Infection	Burns, Blisters	Dermatitus	Strain, Sprain	Misc.	Total
Assembly	900	3								3
	1000	49	30	4	3	5	2	3	9	103
	1200	68	43	6	2	2			4	125
	1500	73	60	1	1			5	4	144
	1600	60	46	5	1	1		4	10	127
Qual. Ctl.										
1900	2000	42	25	3	1	2		2	6	81
Finishing	1700	2		1						3
	5600	13	3		2	2		1	1	22
	5800	1	4			2		1		8
	6000	22	10	2	2	8	1	3	2	50
	7000	6	3	2			1	1	1	14
Qual. Ctl.	7000	1	2	1						4
Machine										
Shop	400-450	16	2	1		1		2	2	24
	500	13	18	2	2	5		1	3	44
	3000	55	14	4		6		4	7	90
	3300	9	9	2			2		1	23
	3500	13	6	4				1	2	26
	3700	60	33	1		5	1	6	16	122
	4000	68	63	11	5	2		3	36	188
	4200	148	51	14	1	7	2	11	19	253
	4500	24	8	4	4	3		2	6	51
	5000	189	79	19	2	7	2	9	29	336
	5300	26	4	1	2	2		1	4	40
	5500	84	30	7	2	1	2	1	6	133
	5700	28	18	6	1	12		4	13	82
Qual. Ctl.	1-100	56	33	1	1	2	3	5	7	108
Maint.	8600	86	45	8	4	5		6	3	157
	8700	1								1
	8800	23	9	2	1	3	1	2	1	42
Pln. & Sched.	200	17	8	2				2	2	31
	300	23	32	6	1	1	1		1	65
	600	1	3			1		2		7
	2300	25	27	5					2	59
Prod. Eng.	7500	4		2		1				7
	8400	21	2	3	1	2		1		30
	8500	79	23	7	3	2	1	2	10	127
Shipping	9000	47	15	3	1			7	1	74
Spec. Mfg.	7800	19	13	3	1			2	2	40
	9300	23	17	1	1	2		4	8	56
	9500	25	12	6		2		2	1	48
	9600	20	6	5	2	3		2		38
Sp.Mf.Q.C.	9400	3				1				4
Def. Wkrs.	2100	8	1							9
	2200	1				1				2
Off. Emp.		117	47	13	3	7	2	11	9	209
Total		1672	854	168	50	106	21	113	228	3212

4. Safety glasses program instituted in certain areas of the plant in June 1954.
5. Safety committee became a line function rather than a staff function in August 1954.

3. Isolation of Causes.

Throughout these studies, the investigators have endeavored to illustrate methods whereby the attention of the safety staff may be focused on the real problem areas rather than the convenient ones. As in the other case studies, a breakdown of accidents by department is often useful; Table 4 is this kind of information. It can be seen that the Machine Shop and Assembly have the largest numbers of injuries. In addition, office employees suffer the least number of injuries although they account for almost one half the total number of man hours. This is not strange because the nature of the hazards is quite different, but it did lead the investigators to direct their attention to the productive departments only. This was the only organization studied where sufficient data were available to pursue this kind of approach.

The rate for the production sections is well within control limits. There is a downward trend but it is essentially stable. Thus, any new casual agent would probably be immediately detected.

III. CONCLUSIONS

At the beginning of this study, three specific objectives were given:

1. to discriminate between period of stable and unstable accident rates,
2. to provide signals of changes in the causal system,
3. to search for assignable causes.

These first two objectives have been thoroughly investigated while the third was impossible to prosecute. In general, it was found that statistical control procedures did distinguish between stable and unstable periods, although it was found that stability is not a universal characterization.

In almost all cases, the use of the control chart did provide signals of the presence of new causal agents. The specific indications were trends, runs above or below the mean, points out of control, etc. It was also found that when a period of stability was followed by a period of instability, the succeeding period of stability was almost invariably at a higher level than the first one. Thus, instability itself was a signal.

The ability of these methods to provide signals is, in part, dependent upon the allocation of data to time periods. Control charts for monthly accident rates provided more sensitive means of detection than shorter time periods, but were slower to detect. Comparison of monthly, bi-weekly, and weekly charts indicated that the bi-weekly chart was usually the more satisfactory. However, it was indicated that this is a topic of investigation which probably will not yield an answer common to all industrial organizations, but rather, each organization should experiment with time periods and choose that one that best satisfies their own needs.

A number of over-all factors were associated with changes in the accident rate for the organization as a whole. These were for the most part, associated with policy changes.

They included such things as increased production rate, plant expansion, overtime work, new products, etc.

"Only by research will needs be determined"

Attempts were made to isolate those groups of people or departments which accounted for the major part of the changes detected by the control charts. In general, breakdown of accident rates and frequencies by department, type of injury, etc. yielded valuable clues. However, this kind of correlation analysis was somewhat ineffective due to the lack of appropriate data.

As a general conclusion, it is apparent that statistical control methodology would constitute a useful tool for safety directors, but only if it is used on a current basis. One common feature of all the case histories was the presence of signals for action. One cannot conclude that appropriate action can be found, but that is a separate research question in and of itself.

A second general conclusion relates to the data themselves; determination of the source of unstable data requires careful analysis and in most cases, the data required were simply not available. The investigators were struck with what appeared to be the lack of knowledge of the accuracy of injury data, and the paucity of detailed breakdown of both injury and exposure date.

The lack of comparability of accident data from one establishment to another makes plant by plant comparisons impossible. The objection might be raised that the operating needs for data differ from the research needs; however, it was clear that no universal idea of the operating needs is held, and only by research will the operating needs be determined.

WINDSHIELD VISIBILITY CLEARANCE

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REGARDLESS of how good the visibility afforded by the windshield and side-windows of a vehicle may otherwise be, the fact remains that under many conditions of weather and road surface, the only area available for reliable seeing is that cleared by windshield wipers.

A. *Avoidance of obstructions*—Certain observations resulting from consideration of the general problem of visibility through windshields, in connection with collision pathways, warrant comment at this time. Photographs were made through the windshields of passenger automobiles showing the roadway and surroundings as seen during actual operation (see Figures 1-4); analysis of these in relation to collision pathways provides some information on the extent and quality of visibility through critical and sub-critical areas*.

In taking these photographs, the eye position adopted as standard for an average driver was located by measuring downward from a "zero" line on the roof of the car to the eye-level of a reference subject. The difference between sitting eye height as previously determined for this subject and the median value from statistical data** is added to the reference measurement, to obtain the eye-level representative of a male in the 50th percentile of sitting eye height, when seated in a natural easy position such as he would assume when driving. Photographs taken from this level have been compared with those taken 1.9 inches above and 1.8 inches below this point to represent the eye levels of the 95th and the 5th percentile males, respectively. Typical pictures are given in Figure 1, and show:

(a) In the 5th percentile eye position the steering wheel obscures a sizeable portion of the critical area; the blind area due to hood and fenders is significantly increased.

(b) Vision through the critical and sub-critical areas from the 95th percentile eye level is not significantly impaired. The tall man, while he sees more of the hood and less of the sky, is probably not seriously handicapped by viewing from this level through a clear windshield; further, changes in the sitting position to reduce eye level by 2 inches does not necessarily result in discomfort.

These observations may be considered from the viewpoint of the provisions necessary for height adjustment of the seat or the subject. It is concluded that the eye level of the 5th percentile men should be raised to the 50th percentile level; but it appears that no useful purpose would be served by raising him above this level. On the other hand, in so far as visibility is concerned there is far less need—if indeed, any—for lowering the eye level of the tall man. The greatest benefit that might accrue would be when viewing an upgrade ahead while driving downhill.

In addition, the photographic studies have emphasized

*The critical area of the windshield is defined as that through which is seen the road and its shoulders ahead of the vehicle, and must be entirely free of any obstruction. In the surrounding sub-critical areas some minor obstructions or obscuration may be tolerated if unavoidable.

**A.A.F. Tech. Report No. 5501, June 1946: "Human Body Size in Military Aircraft and Personal Equipment".

"The wrap-around design can produce severe distortion . . ."

that the far left edge of the windshield and the left corner-post are crucial, since the critical area extends to this region. The central part of the windshield is of lesser importance, because it includes (in general) none of the critical area; but since a part of this region is sub-critical, it must not be ignored or neglected.

Recent developments in commercial windshield design for passenger cars has followed two lines: (a) The center-post has been eliminated, by the use of a curved windshield. (b) Efforts have been concentrated on moving the corner-post backward, to increase the windshield area—with less effect on the visual angle than might be supposed—by sharp curvature of the glass toward the sides.

This "wrap-around" design can produce severe distortion at the edges, because of the curvature, which constitutes a definite obscuration or even obstruction of vision. Furthermore, the arrangement introduces areas at the edges which cannot be cleared by the wipers. It is not unlikely that the net effect on over-all visibility may be deleterious.

1 a. Tallest drivers (95th percentile): upward visibility lost, with no significant advantage in extent of road or surroundings seen.

1 b. Median drivers (50th percentile): approximately optimum range of view.

1 c. Shortest drivers (5th percentile): note obstruction of road by steering wheel and also hood.

Figure 1. Views through clear windshield of a 1954 Ford sedan, showing the road and other areas as seen by drivers ranging in height to both extremes, as for actual operation of the car. The eye positions were located by calculating differences from the measured median for men in the various percentile of sitting height from the fifth (very short) to the ninety-fifth (very tall).

In any event, our analyses lead to the definite conclusion that less benefit can be achieved by moving the corner-posts back than by narrowing them to less than 2½" projected width (preferably to 1½" or 2"), where they cannot block the line of sight from both eyes simultaneously and would constitute only a minor obstruction, even if this design should require a center-post of equal* size for reasons of structural strength. Although this is not an easy design problem, because the corner-posts support the doors as well as the roof, its great importance would seem to warrant a very considerable effort.

In this connection, one might ask why it is worse to have an area on the windshield which cannot be cleared by present wipers than to provide a corresponding side-window area which is at least as difficult to clear and also further to the rear. The answer is that because of the pattern of air-flow around a moving vehicle, the windshield collects far more obscuring materials of any type—whether rain, snow, road-dirt, or other—than do the side and rear windows. Uncleared windshield areas are obscured (if at all) much more severely than side windows. Also of major importance is the fact windows can be opened to obtain unhampered vision, if necessary.

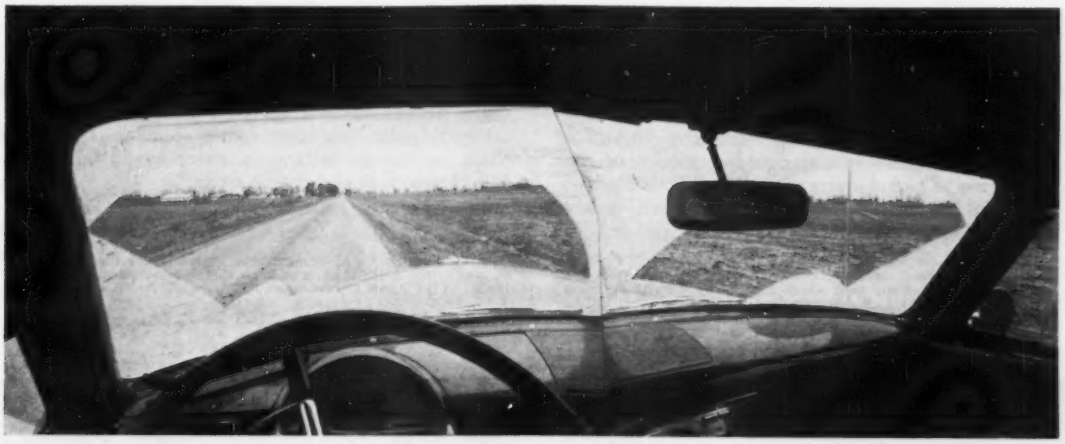
A common interference with upward visibility is produced by the opaque outside sun-visor, which obstructs far more than is lost from an eye-level less than two inches above the median, and is difficult to "duck under". Upward angles of vision are important not only for seeing traffic lights or low bridges, but especially when descending into a valley, in order to see vehicles approaching down the opposite slope. One simple alternative for reducing glare is the installation of a strip of transparent filter material along the top edge of the windshield (generally colored green in the forms available commercially at very low cost), to lower the apparent brightness of the sky without totally blocking off vision.* In any case, it is recommended that no outside sun-visor or other such obstruction to visibility should be installed unless so constructed that it can quickly and easily be swung completely out of sight line by the driver while operating the vehicle.

Provisions for maintaining the quality of vision through all transparent areas are considered essential for all military transport vehicles except those without fixed windshields. This is considered especially important for military vehicles, inasmuch as they are often involved in both night and day operations off of paved roads or in convoys where they must follow other vehicles closely. The solution is to install the windshield washers available commercially, which spray water onto the glass to loosen the sticky dirt sufficiently for the wipers to clear it off.

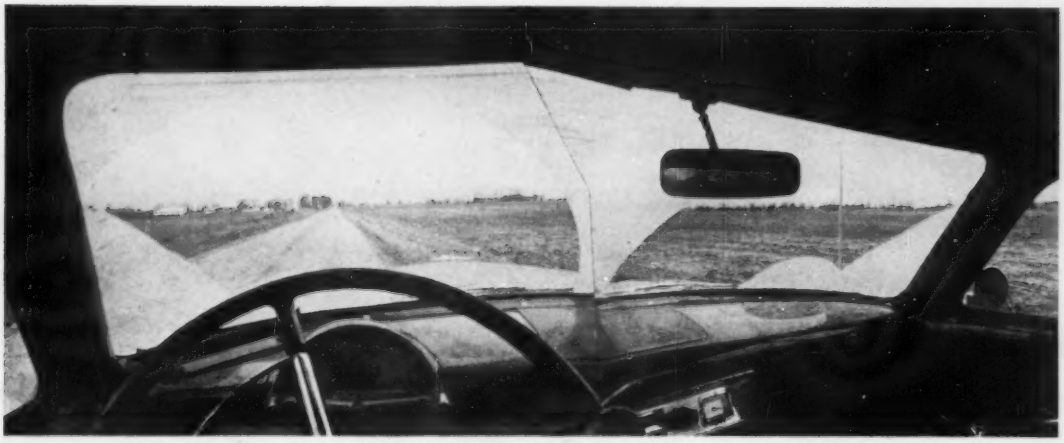
B. *Wiper patterns*—Based on the general considerations above, the experimental investigation of the various possi-

*But not greater, since this obstruction should also be only a minor one.

*A similar inexpensive device found to be most helpful is the filter attached so that it can be swung down over the inside rear-view mirror to reduce headlight glare from a following vehicle to a tolerable level without entirely losing the use of the mirror.



2 a. Tallest drivers (eye-level for 95th percentile).



2 b. Average drivers (median eye-level: 50th percentile).

2 c. Shortest drivers (eye-level for 5th percentile).

Figure 2. Standard windshield-wiper pattern on a 1954 Ford sedan, using extra-length blades (12" instead of 11") on the conventional equipment supplied with the automobile, where the wipers point to the center when "parked" flush with bottom of windshield. The three pictures show the outside areas seen through the pattern as in actual operation by drivers of various heights from very short to very tall (as in Figure 1). Note the marked improvement from (c)-(b), and in (c) the vehicle on the road ahead largely concealed by the wheel.

"Rectangular sweep misses critical edges"

ble windshield-wiper arrangements and the corresponding patterns was continued and considerably expanded. Without restrictions, the geometrically optimum arrangement for a rectangular windshield is a straight-line motion of the wipers to clear a rectangular area extending to both edges of the windshield.** As far as we know, however, such a sweep is not practicable on a curved windshield. Furthermore, neither flat nor curved windshields in current use are rectangular, but more nearly approach a trapezoid in shape, so that the rectangular sweep would fail to provide full clearance at the critical edges.*

For these reasons, and especially for the sake of design

**Even in this case, at least two wipers would be needed in order to minimize the time between successive sweeps across edge areas especially (i. e., to provide a sufficiently high sweep frequency) without requiring excessive speeds for the travel of the wiper blades across the glass.

*This difficulty could be overcome by tilting the blades to change the rectangle into a rhombus; two such rhombic sweeps might then be overlapped at the center to cover the entire trapezoid.

4 a. 2 wipers, conventional type, with wipers pointing outward when "parked" flush with bottom of windshield.

4 b. 3 wipers, top-mounted, conventional type.

Figure 4. Hypothetical windshield-wiper patterns on a 1954 Ford sedan, showing the road and other areas visible from the median eye-height. Both patterns illustrated are produced by fixed-angle (conventional) blades, but in the latter case (b) the pivot-points are not symmetrically placed. *Note:* For both patterns, it is assumed that the blade (when horizontal) can follow the windshield curvature at the outside edge; but this is not true for present blades on this automobile nor on most passenger cars in current production.

"Optimized sweep was plotted for passenger car"

simplicity, we have considered only the rotary type of wiper, with a circular stroke—i.e., a fixed length of wiper arm. The first stage was a purely theoretical analysis of possible ways to cover the crucial regions of a trapezoidal area with sweeps of this type, by adjusting such parameters as the location of the pivot point, the lengths of the wiper arm and the blade, the angle between these, the length of the wiper stroke, and so forth—ignoring any practical restrictions, in order to determine general principles. (These parameters are, of course, largely interdependent, as restricted by the shape and size of the windshield boundaries.) This analysis soon showed that circular sweeps are not too well adapted for the rather elongated, shallow windshield shapes in current use, with the chief difficulty arising from the attempt to lengthen the arc of the sweep while obtaining the proper angles for the blade as determined by the windshield edges at its positions at the ends of the stroke.

3 a. 2 wipers only (variable-angle blade at left, fixed-angle in center).

3 b. 3 wipers: as above plus right-side wiper with fixed-angle blade.

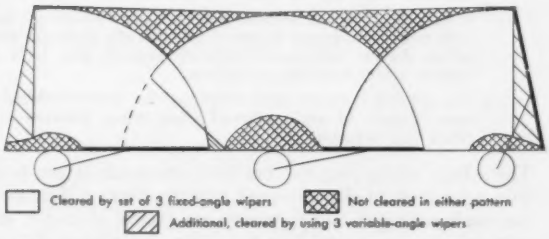
3 c. 3 wipers: same except variable-angle blade on right-side wiper.

Figure 3. Proposed windshield-wiper patterns, using a variable-angle blade (cf. text) on the driver's side (left), as seen on a 1954 Ford sedan from the eye position for a driver of median height. The central wiper has a fixed-angle (conventional) blade in all cases illustrated; but the right-side wiper for the passenger is omitted in one case (a), and is shown with both fixed (b) and variable-angle (c) blade in the other two cases.

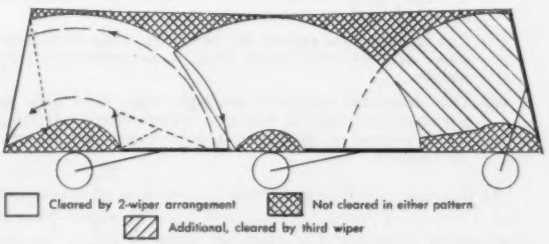
From this basis, a geometrical construction was developed to determine the pivot-point location required if the blade is to reach specified positions flush (i.e., parallel) with the side of the windshield at one end of the sweep and with the bottom at the other end. The resulting "optimized" sweep was plotted for a typical passenger car, and is rated as a definite improvement over the standard one, even though it is narrower than desirable. Unfortunately, however, because the improvement is largely due to the long radius of stroke required to reduce the angle of sweep around the pivot, this pivot-point must be located a considerable distance away from the edge of the windshield —not less than 8 inches in the cases treated. Although this distance depends on windshield shape and size, it was concluded that such an arrangement would not be practical from the stand-point of current engineering design—at least, in any case where it might offer a real improvement. Nevertheless, this approach served to demonstrate two points:

(a) No greater improvement is possible with two wipers of conventional design and arrangement (symmetrical pivot locations).

(b) In developing more practical solutions, even small shifts of the pivot away from the windshield can be advantageous.


Cleared by set of 3 fixed-angle wipers
Not cleared in either pattern
Additional, cleared by using 3 variable-angle wipers

(a) Proposed two- and three-wiper patterns (as photographed for Figures 9a and 9b) using variable-angle wiper on left (driver's) side, with conventional (fixed-angle) wipers elsewhere.



(b) Possible three-wiper patterns, showing one of the best patterns using conventional (fixed-angle) wipers only, and the gains achieved by substituting variable-angle blades (without other change).

Figure 5. Proposed Wiper Patterns: demonstrating uses of the variable-angle wiper (see Figure 7). In (b), the center wiper of this type has a reverse variation, in that the blade shifts in the opposite direction (relative to the sweep) from the design used at the sides. Another of the series of patterns seen in (a) above is shown in Figure 3c, with a variable-angle wiper at both sides instead of at the left only.

"Some desirable patterns are impossible with conventional wipers"

In consequence, attention was turned to exploring other approaches indicated by the theoretical analysis, with the pivots restricted to the areas 2" to 4" wide which are available for mounting them at the top and bottom edges of the windshield on current cars. A mock-up of the windshield and cowl of a 1954 Ford convertible was constructed from standard Ford parts, for testing, evaluating, and demonstrating experimental wiper arrangements and patterns. The shape of this one-piece, partial wrap-around windshield was taken as the standard for test purposes, and pivot-points were uniformly taken as centered 2" from the windshield edge (to allow for mounting space on a cowl 2½" wide). A great variety of sweep arrangements were plotted accordingly (similar to Figures 5-6), and any that seemed at all promising were tested on the mock-up. The best patterns were transferred onto a 1954 Ford sedan,* and windshield photographs were taken as described above to show the road and surrounding areas as they would appear to the driver (e.g., Figures 3-4).

In most cases, photographs were taken from each of the reference eyelevels,** and Figure 2 shows such a set of three pictures for the standard windshield wipers supplied with the car. The differences due to the shifts in eye height are striking:

(a) The shortest drivers suffer markedly greater visual obstruction from the uncleared areas left by the windshield pattern, as well as by the steering-wheel, hood, and other structures, than do the other two groups.

(b) It is difficult to determine whether the median or the 95th percentile group is better off over-all; although the tallest drivers lose some visibility upward, they have a slightly wider field on the horizon.

(c) The general conclusions drawn from the clear-windshield case (Figure 1) are confirmed when wiper patterns are taken into account.

The effects of varying the eye-level are much larger here than with most of the improved wiper patterns (illustrated for median height only), where the greater clearance results in changes resembling those detailed previously for the clear windshield. The deficiencies of this standard wiper pattern are seen by considering the photographs in the light of the criteria established:

(a) A large region of the critical area remains uncleared at the left side of the windshield.

(b) The large central region left obscured, while including a good deal of sub-critical area, is of somewhat lesser weight.

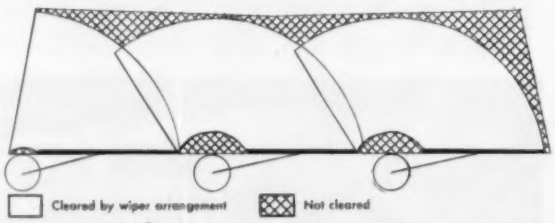
(c) The obstructed region at the right edge is of little importance (although it may also include some sub-critical area), because of its smaller angular extent and less critical location.

As this investigation progressed, a number of other practical limitations were encountered on the wiper patterns that can be achieved. For example, some desirable patterns are impossible with conventional wipers because the extent of the sweeps is limited where the end of the blade encounters the edge of the windshield; Figure 4(a) shows an instance of this, for a pattern which was previously standard on a number of cars. This pattern also illustrates another point: that a sweep where the blade points outward when flush with the top or bottom of the windshield can be achieved in practice only if the windshield curvature is small enough so that the blade can follow it in this position.

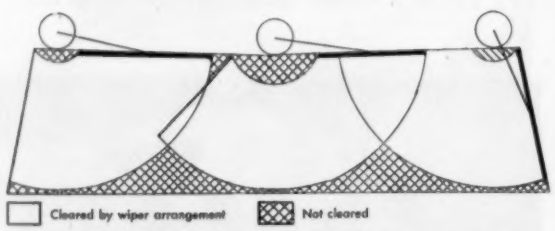
On current windshields with considerable curvature such patterns cannot be used with present blades; other instances of arrangements possible only on "flat" (low-curvature) windshields are seen in Figures 4(b) and 6(a). In addition, patterns must be arranged so that the blades can be "parked" correctly at the edge of the windshield, to cause minimum obstruction; in the drawings of Figures 5-6, therefore, the wipers are shown in the "parked" position. Similarly, any overlap of the sweeps must be such as to permit a proper synchronization to avoid interference.

The degree of variation found between windshields on different vehicles is great enough to prevent single solution from being adequate in all cases; and under some of the restrictions considered, a new modification is necessary for almost every variation.

Under the limitations imposed, it was found that with wipers of a conventional type no satisfactory two-wiper pattern could be arranged. The addition of a third wiper can give an adequate pattern, but the specific solution to



(a) Hypothetical three-wiper pattern with asymmetric pivot points. The right-side wiper points outward (right) when "parked" flush with bottom of windshield.



(b) Possible three-wiper pattern, with symmetrical top mounting of the pivot points to produce full edge clearance with fixed-angle blades.

Figure 6. Possible Wiper Patterns: demonstrating use of three conventional (fixed-angle) wipers to obtain improved clearance. For (a), the windshield must be flat enough so the right-hand blade—when horizontal—can follow its curvature at the outside edge (see Figure 4). The arrangement of (b) gives one of the best "fixed-angle" patterns, provided the windshield dimensions permit the "peaks" at the bottom to be kept low enough for visibility by short drivers; here even sharp windshield curvature would be permissible. In both this and the preceding figure, the blades are always shown in their "parked" positions, and the windshield proportions used are those for a 1954 convertible (2" shallower than for the sedan).

*In most cases, slight modifications were made to take advantage of the 2" extra windshield height available, as compared with the convertible—equivalent, for example, to using longer blades.

**The possibility is not being overlooked that the photographic methods and equipment evolving for this purpose might result in an apparatus immediately adaptable to a simple technique of photographic goniometry for alternative or supplementary use with the present instrument.

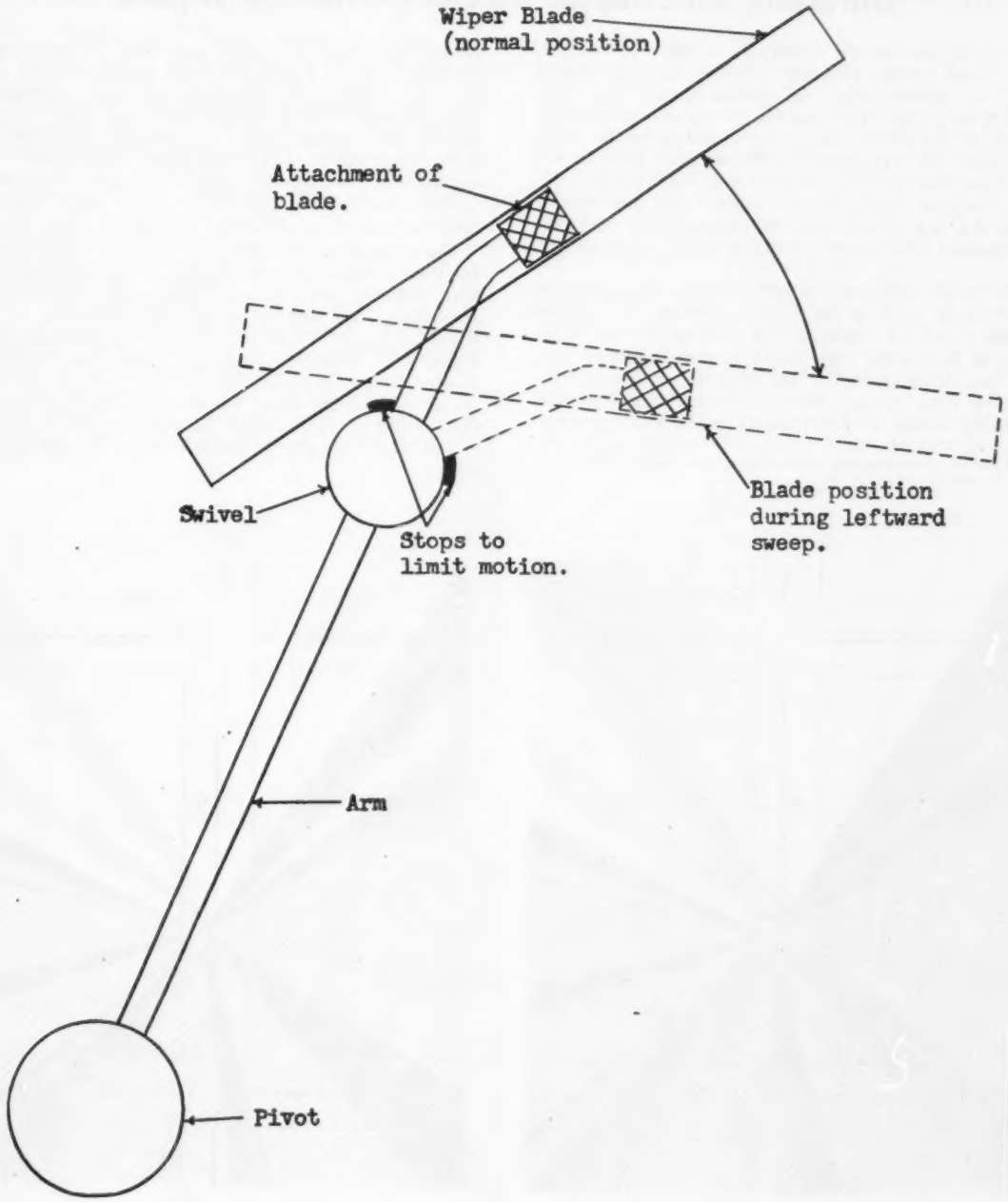


Figure 7. Variable-Angle Wiper, showing one of the many possible types of construction. The sketch is to illustrate the basic principles of this type of wiper: A swivel permits the angle between blade and arm to vary depending on the direction of the sweep. Stops are provided to control the two limits (and extent) of this variation; these would ordinarily be adjusted to set the blade parallel to the edge of the windshield at both ends of the sweep. The position of the swivel is far enough inward toward the pivot from the center of the blade (where the attachment point is located, approximately) so that the drag of the windshield varies the angle automatically during the sweep—aided by the fact that the outer half of the blade travels a much greater distance than the inner half.

"Different windshields call for different wipers"

be used depends on the windshield design. For example, on a curved windshield when the pivots must be mounted along the bottom edge, the pattern shown clear (unshaded) in Figure 5(b) seems to be the best compromise, despite its deficiencies; but if top mounting of the pivots is possible, the arrangement in Figure 6(b) gives an improvement. On the other hand, for a "flat" windshield*, the pattern of Figure 6(a) appears better yet, since it leaves less obscuration along the bottom edge, while the top-mounted arrangement of Figure 4(b) is less satisfactory.

The major difficulty encountered was in maintaining proper blade angle at the windshield edges for adequate clearance and for "parking". A solution to this which could be carried out very simply in many different ways, requiring relatively minor modifications of present conventional wiper designs; is a variable angle wiper arm. One possibility is illustrated in Figure 7, which also shows how the angle between the blade and arm changes in the course of the sweep. In Figure 5(a), the left-hand wiper is of this type, and the drawing shows the area swept during each direction of travel to illustrate its operation. The degree of improvement which can be achieved in this way is seen from Figure 5(b), while Figure 3 illustrates several applications. An experimental working model of the device has been constructed, to prove the practicality of the principle, but further development is desirable to perfect details.

The variable-angle arm permits a two-wiper pattern which is much more nearly satisfactory than anything possible with two conventional (fixed-angle) wipers; an example useful for both curved and flat windshields is illustrated in Figure 3(a)—and also shown schematically in Figure 5(a). Another possible application is on windshields divided by a center-post into two flat halves, preventing the use of a central wiper, for which an adequate modification of one of the standard patterns—as seen in Figures 2 and 4(a)—should be possible with the help of this device.

*Of course, an arrangement suitable for a curved windshield can normally be used also on a flat one.

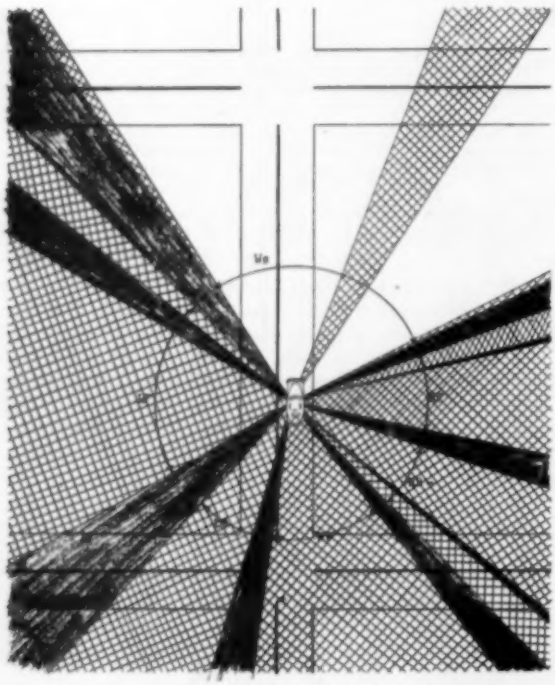


Figure 8-a. Automobile Visibility in the Horizontal Plane: Standard Wiper Pattern. Diagram illustrating angles of view cleared by standard windshield wipers on a typical passenger car (1954 Ford sedan) at the eye-level of a median-height driver, in contrast to total windshield and window angles. This is the pattern seen in Figure 2b, produced with extra-length (12"), fixed-angle blades on the conventional equipment supplied with the car.

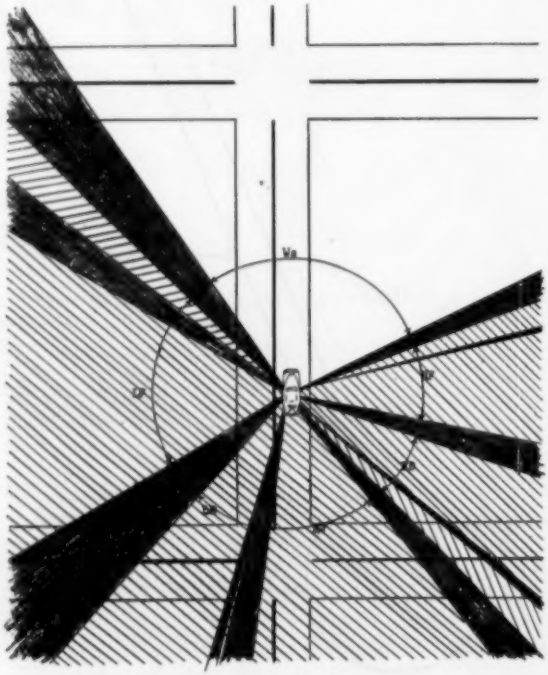


Figure 8-b. Automobile Visibility in the Horizontal Plane: Improved Wiper Pattern. Diagram exactly similar to preceding, but for angles cleared by an improved three-wiper arrangement on the same 1954 Ford sedan at the eye-level of a median-height driver. This is the pattern seen in Figures 3b (and 5a), produced with a variable-angle wiper on the left (driver's) side plus two fixed-angle wipers, all with 12" blades. Diagram is approximately to scale for a road, 24 feet wide, with car 100 feet from intersection ahead.

Legend: Unshaded sectors —Cleared by windshield wipers.
Shaded sectors —Other window areas (not wiped).
Blackened sectors —Blocked by permanent obstructions.
Ws—Windshield. LF/RF—Left/Right Front window and panel.
RV—Rear-View window. LB/RB—Left/Right Back side-window and panel.

"Variable-angle wiper principle is promising development"

When a third wiper is feasible, the use of the variable-angle arm permits a really satisfactory basic three-wiper arrangement which is adaptable to a wide variety of windshields (curved or flat) without requiring top-mounted pivots or other expedients. The best such pattern, employing equal sweep angles for all three blades, is illustrated in Figure 3(c); that of Figure 3(b) is very nearly as good, but requires a different sweep angle on the right-hand (conventional) wiper.

The variable-angle wiper principle is a particularly promising development, not only because it can be applied with such simplicity of design, but chiefly because the design changes can be limited to the arm—and/or perhaps the blade. In consequence, such wipers could be installed on vehicles now in use even without changing the existing pivots, to obtain improved patterns in many cases (especially on older cars with less wide windshields), although maximum benefits would generally require relocation of pivot points, including any feasible shift away from the windshield edge.

In order to evaluate the improvement which can be made in wiper patterns, measurements were made of the angular widths of the cleared areas on the windshield of our experimental sedan (1954 Ford), as well as of the windshield itself and the side and rear windows, both for the standard two-wiper pattern of Figure 2 and for one of the best three-wiper arrangements permitted by the variable-angle blade—that shown in Figures 3(b) and 5(a). The results in the horizontal plane through the median eye-level are illustrated in the "lighthouse" diagrams of Figures 8-a and 8-b, where the unshaded regions are visible through the areas cleared by the wipers, while the sectors in black are permanently blocked by posts and other structures; and the same comparison is made in Figures 9-a and 9-b for an angle of 6° below the horizon from the median eye position, which represents approximately the angle of depression to highest point of the hood.

These results emphasize the complete clearance all across the windshield provided by the improved pattern in the horizontal plane, as well as its advantages at 6° down-

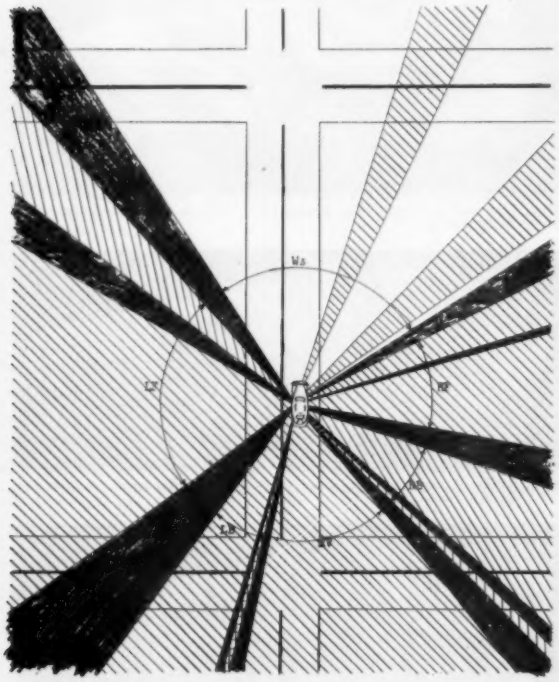


Figure 9-a. Automobile Visibility at 6° Downward: Standard Wiper Pattern. Diagram similar to Figure 8-a, illustrating angles of view cleared by standard windshield wipers on the same 1954 Ford sedan, but as seen at a 6° angle of depression from the eye position of a median-height driver, as contrasted with total windshield and window angles. This is the same standard pattern as before (seen in Figure 2). The downward angle of 6° represents approximately the depression angle to the highest point of the head.

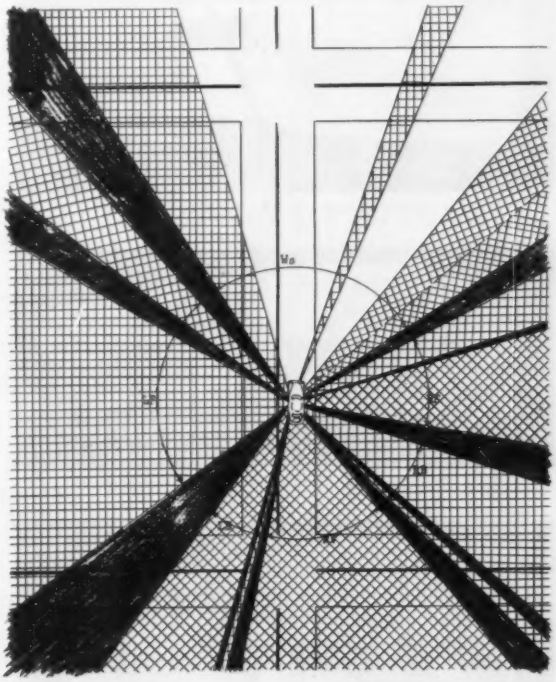


Figure 9-b. Automobile Visibility at 6° Downward: Improved Wiper Pattern. Diagram exactly similar to the preceding, but for the improved 3-wiper arrangement, on the same 1954 Ford sedan as seen at the 6° angle of depression which approximately grazes the highest point of the hood, measured from the eye position of a median-height driver. This is the same improved pattern as before (Figure 8-b). The uncleared windshield areas are two of the "humps" left by the inner ends of the blades, which protrude just slightly above the coordinate line for 6° down, and thus obstruct a very little outside area beyond the hood line.

Legend: Unshaded sectors —Cleared by windshield wipers.
Shaded sectors —Other window areas (not wiped).
Blackened sectors —Blocked by permanent obstructions.
Ws—Windshield. LF/RF—Left/Right Front window and panel.
RV—Rear-View window. LB/RB—Left/Right Back side-window and panel.

"Pivot points key to better wiper performance"

ward, where the total angle left obscured is only half as wide as for the standard arrangement. Numerical comparisons are provided by the following table, giving the sum of the angular widths shown on these diagrams for each of the indicated regions, where the "Total Glass Area" includes the side and rear windows in addition to the windshield. The figures for per cent clearance of the windshield are the most significant for comparison of wiper patterns, while those for percentage cleared of the total glass angle would indicate the situation whenever conditions should be so bad as to obscure significantly the side and rear windows as well as the uncleared windshield areas—i.e., all the shaded regions on the lighthouse diagrams.

C. *Wiper Clearance of Panoramic Windshields:*

On the problem of the full wrap-around windshield, the 1955 Report stated that "The small areas as both edges outside the regions of sharp curvature is designed . . .". The solution suggested in this quotation has since been developed commercially. Specifically, a manufacturer* has just recently put on the market a new "Contour-Sweep" blade (available on an electric wiper) which can achieve

Total Plane Angles for Various Glass Areas on a 1954 Ford Sedan:

	Cleared (*Total*) Standard Wipers	Improved Pattern	Windshield: Total	Total Glass Area
Horizontal Plane:				
Angle—total	83.5°	98.5°	98.5°	295°
(Fraction of circle)	(.232)	(.274)	(.274)	(.819)
% Clearance: Windshield	84.8%	100 %	——	——
% of Total Glass Angle	*28.3%*	*33.4%*	33.4%	
6° Downward:				
Angle—total	51.5°	71°	90°	300°
(Fraction of circle)	(.143)	(.197)	(.250)	(.833)
% Clearance: Windshield	57.2%	78.9%	——	——
% of Total Glass Angle	17.2%	23.7%	30.0%	——

10 a. Tallest drivers (eye-level for 95th percentile).

10 b. Average drivers (median eye-level: 50th percentile).

10 c. Shortest drivers (eye-level for 5th percentile).

Figure 10. Standard Wiper Pattern on a 1950 Plymouth Sedan: a typical divided windshield, showing the road and other outside areas seen through the pattern as in actual operation by drivers ranging in height to both extremes. This pattern is from the conventional equipment supplied with the automobile (12" blade), where the wipers point outward when "parked" flush at the bottom. Note the serious obstruction to the left side of the road, especially in (a), and the wide central blockage.

11 a. Standard equipment with longer (15½") blade at modified angle and wider sweep.

11 b. Effect of variable-angle wiper (with 13¼" blade) to allow more extended sweep.

11 c. Same except with pivot-points shifted outward for better clearance at sides.

Figure 11. Improved Wiper Patterns on the 1950 Plymouth Sedan: three variations as seen by a driver of median eye-height (cf. Fig. 10 B). In (a) is seen the improvement at the center and bottom achieved with conventional equipment by minor changes from standard, while (b) shows the further gains produced by variable-angle wiper arms—still with the original pivots. Shifting the pivots 10½" outward, so that the wipers point inward when "parked," gives pattern (c) with variable-angle wipers.

"Contour wipers needed for panoramic windshields"

a high enough curvature so that it "cleans clear around the corners of panoramic windshields."

On this type of windshield, because of its great width (relative to height), such blades could be used with conventional arms in a two-wiper arrangement where each blade sweeps down to the bottom of the windshield on both sides of its pivot, clearing nearly a semi-circle. This could be extended to a full semi-circle with a variable-angle wiper arm (discussed below—see Figure 14 using a blade of this type, whereby the sweep could clear flush to the bottom on both sides of the pivot.

Better clearance could be achieved at the sides and center of the panoramic windshield, especially toward the top, with arrangements of three or even four wipers (as needed), which could be adapted directly from the previous solutions developed for the partial wrap-around windshield (1954 Ford). As with these earlier solutions, application of the variable-angle principle would help to improve clearance and simplify arrangements.

*Delco Appliance Division of General Motors Corporation, Rochester 1, New York. The quotations here are from advertisements for the "Power-Sweep Contour Electric Windshield Wiper with exclusive 'Contour-Sweep' Blade".

12 a. Tallest drivers (95th percentile): note particularly the left side clearance.

12 b. Average drivers (50th percentile): compare with standard pattern (Fig. 6 b).

12 c. Shortest drivers (5th percentile): only minor obstruction at the center.

Figure 12. Proposed Wiper Pattern on the 1950 Plymouth Sedan: an asymmetric combination of the two variable-angle wiper arrangements of Figures 11-c (on the left) and 11-b (right). Because the center-post of the divided windshield prevents a central wiper, only two-wiper patterns were considered, of which this appears best. Comparing results for the three eye-levels with the corresponding ones of Figure 10 shows the improvement in clearance, especially at the (upper) left and centrally.

D. *Wiper Patterns on Divided Windshields:*

A more detailed analysis was required in the case of the divided windshield, with a center-post that prevents the use of a central wiper—which afforded the best solutions for the one-piece windshield. A 1950 Plymouth P-20 sedan was chosen as a representative example. Using the same approach and techniques as before, photographs were made through the windshield to show the roadway and surroundings as seen during actual operation (Figures 11-13).

The first set of three pictures—Figure 12—shows the pattern of the standard windshield wipers supplied with the car, for drivers of three different eye heights corresponding to the median and two extremes (5th and 95th) percentile of the male population. For this pattern, the marked differences due to the shifts in eye height are opposite to those noted on the 1954 Ford:

(a) The tallest drivers suffer the greatest visual obstruction from the areas left uncleaned by the wipers, especially at the (upper) left side.
(b) The shortest drivers have the best over-all view, but their advantage over the median group is not great.
(c) In this vehicle, the hood and steering wheel do not constitute serious obstructions even for the 5th percentile group.

On the other hand, the deficiencies in this standard wiper pattern are broadly similar to those noted previously, although differing in degree in the various areas:

(a) A large region of the critical area remains obscured at the left side of the windshield (widening toward the top); this appears to be a serious hazard which increases with driver height.
(b) The unduly large central region which remains uncleared is of lesser importance, but includes a good deal of subcritical area.
(c) The obscured region at the right side is of minor significance.

The differences from the Ford standard pattern are due in part to the narrower windshield and shorter sweep, but primarily to the more central pivot locations, so that the wipers point upward centrally and outward at the bottom. If this is reversed to produce an arrangement like that of the Ford—by shifting the pivots outward until the wipers point upward at the edges and inward in the center—the pattern is that seen in Figure 15-b, where the clearance is somewhat less inadequate than in the standard pattern of Figure 15-a (and 11).

From this foundation, a wide variety of possible solutions were attempted on the same basis as previously, restricted to rotary wipers of fixed arm length. Furthermore, only two-wiper arrangements were considered, because of the centerpost dividing the two (flat) halves of the split windshield. Since the great majority of such windshields are found on older vehicles not in current production, the program included specific attention to the development of some (partial) solutions which could be applied to cars already in use with a minimum of conversion. The pattern of each sweep arrangement considered was plotted on paper (as in Figures 15-17), and the most promising were transferred onto the 1950 Plymouth for photographing. No mock-up was employed for this windshield.

The geometrical construction for an "optimized" sweep was carried out in several different ways. Typical results

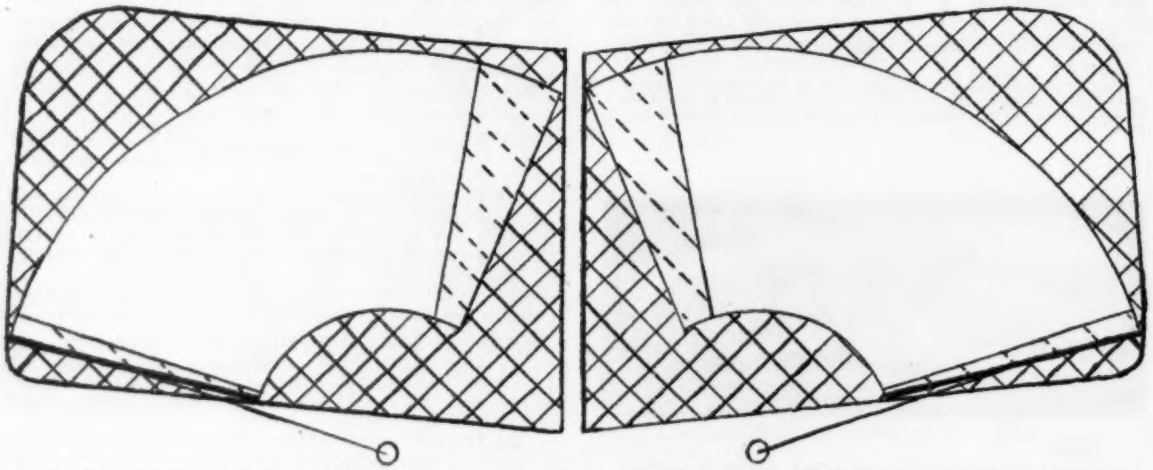
"A longer sweep offers a small gain"

are shown in Figure 17-a, and represent a significant improvement over the standard pattern. But unfortunately, the pivots must be shifted to locations 5½" down from the windshield edge, which are considered impractical to achieve (although the case is less extreme than with the Ford, where 8" or more is required). All other arrangements tried were restricted to pivots within 2" of the windshield, and thus on the cowl.

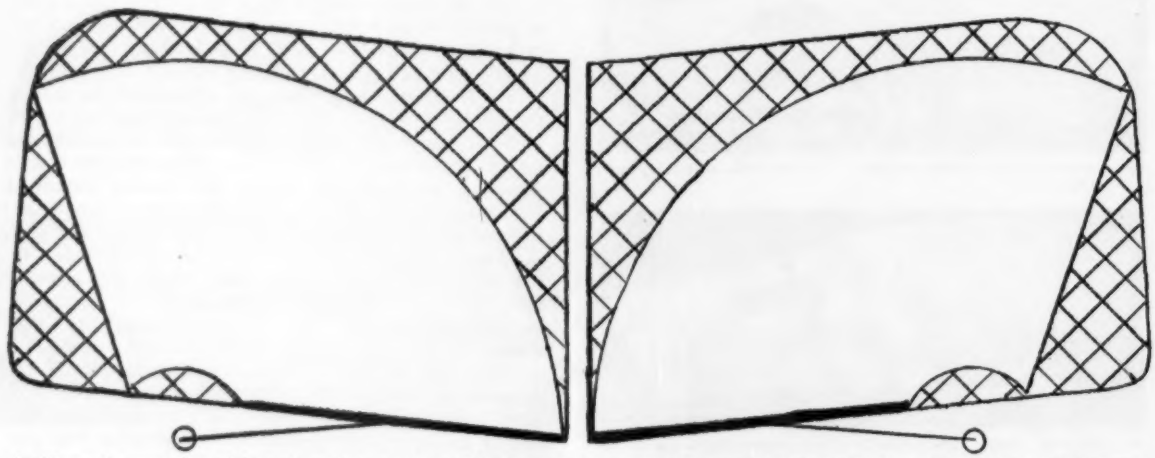
An immediate small gain over the standard pattern of Figures 11 can be achieved merely by using a longer sweep, as shown in Figure 15-a. Somewhat more improvement is obtained by adjusting the length and angle of the blade as well as the sweep width to get the pattern photographed in Figure 12-a. With different pivot points, the asymmetric pattern of Figure 16-a can be obtained, for a significant gain of clearance.

Further improvements depended on using the variable-angle wiper principle developed in previous work on this project, as illustrated in Figure 14. A prototype variable-angle wiper arm was constructed to the design shown here, and placed in use on the windshield mock-up (for the Ford). This prototype operates in full accordance with the theoretical analysis, and thus has demonstrated that the principle is both practical and effective.

Most of the arrangements described above can give better patterns when variable-angle wipers are employed. For in-



(a) Standard wiper pattern (as photographed in Figure 12) using original equipment and arrangement (12" blade, pivots 1½" down and 8" out from center), and the effect of extending the sweep only.



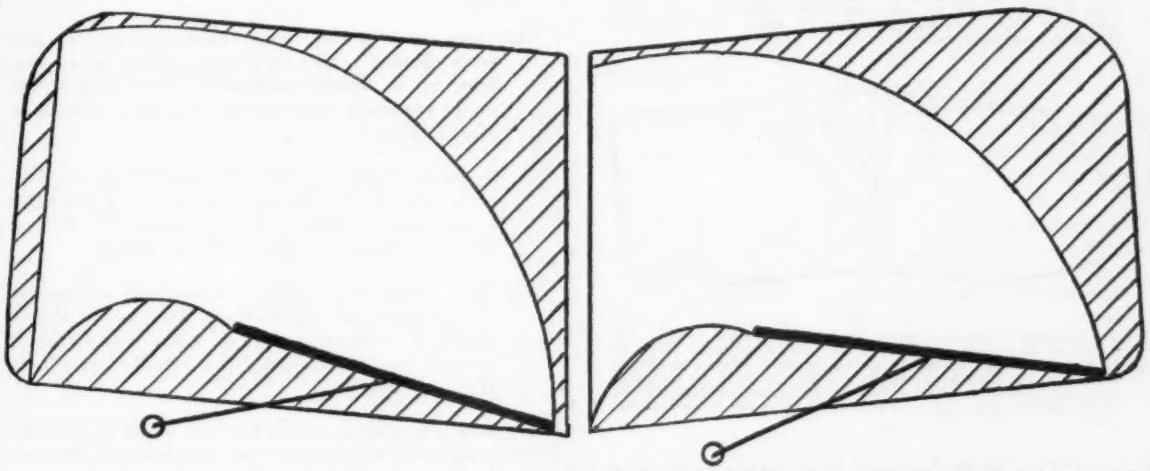
(b) "Inverse" pattern, from shifting pivot-points outward to 17½" from center-post (still 1½" down from windshield edge), so that wipers "park" inward at bottom, using 14½" blade with maximum available sweep.

Figure 13. Conventional Wiper Patterns for a Divided Windshield: drawn for a 1950 Plymouth P-20. These two patterns contrast the results from the two wiper arrangements in most common use. In (a), the pattern produced by the original equipment is seen (as well as the gains available if a longer sweep were used). The "inverted" pattern (b) is more frequently seen today; at the sides it shows gains above and losses below in comparison with (a), but conversely at the center. Wiper blades are shown in their "parked" positions in this and the next two pages of drawings. Scale 1:8.

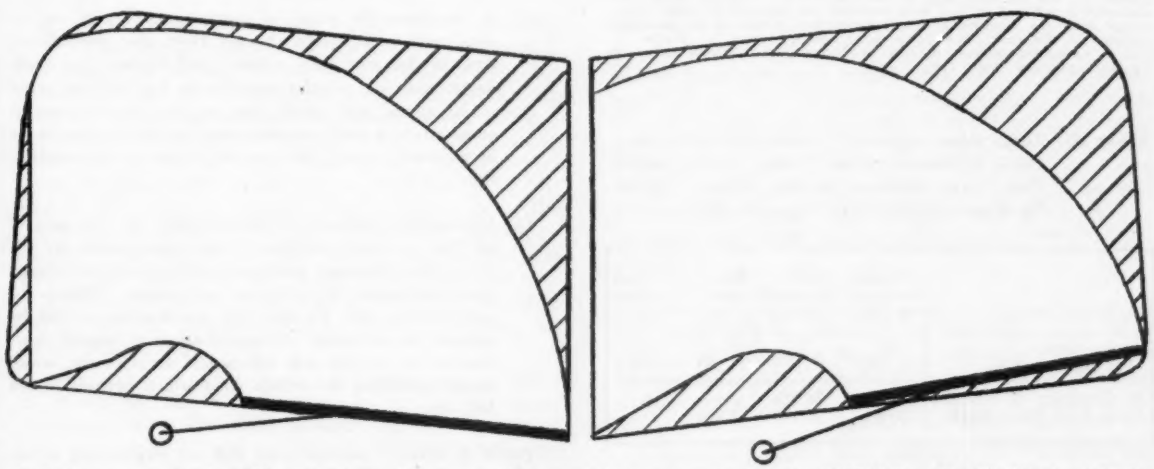
"Most arrangements work better with variable-angle wipers"

stance, Figure 12-b shows the gain over Figure 12-a thus obtained with the original pivot points, while in Figure 12-c the still better pattern achieved by using outside pivots is seen (compare also Figure 15-b). Combining these last two patterns gives the result plotted in Figure 16-b, and photographed for drivers of various eye heights as shown in Figure 13. This was the best pattern achieved, and is rated as at least adequate (but not fully satisfactory). For reference purposes, the best top-mounted wiper arrangement is drawn in Figure 17-b; but top mounting is less successful in this case than with the Ford, because the shape and proportions of the windshield are not so well adapted to it.

The very real improvement in wiper clearance achieved with the arrangement of Figure 13 (and 16-b) is evident from the photographs, as well as the much smaller differences in visibility between the different eye heights, in comparison with Figure 11. These gains are also demonstrated in Table III, which gives the results of measurements on the cleared windshield areas for the patterns of Figures 11-b (standard) and 13-b (proposed), in terms of their angular widths on the horizon. The figures for per cent clearance of the windshield are the most significant for evaluating wiper patterns, while those for percentage of total glass angle apply when side and rear windows are obscured as well at the windshield.



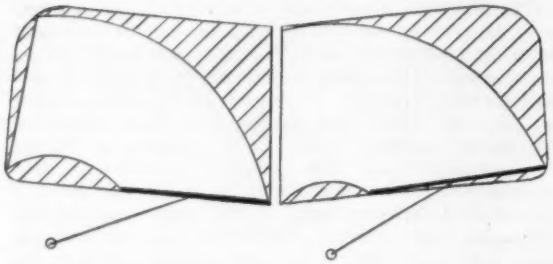
(a) Asymmetric arrangement of conventional wipers, with right-side pivot shifted inward from original location to 5¾" out from center, and using blades 15" long on the left side and 16" long on the right. Sweep angles are approximately equal.



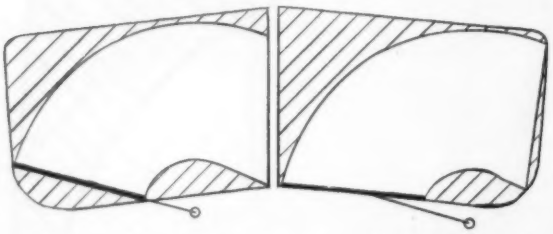
(b) Similar arrangement of variable-angle wipers, with correspondingly extended (equal) sweeps, and using 13¼" blades. The right-side pivot is in the original position (8" in from center). This is the pattern photographed in Figure 14.

Figure 14. Proposed Asymmetric Wiper Patterns for a Divided Windshield: drawn for the 1950 Plymouth P-20. For these patterns, the pivot-point on the left (driver's) side is shifted outward to 18½" from center, for full clearance at the left edge; and the right-side wiper is also arranged for best leftward clearance (with its pivot close to center). All pivots are 1½" down from the windshield edge. The increased clear area in (b) from the use of the variable-angle wiper (see Figure 7) is obvious, as well as the better parking position which can thus be obtained (as drawn). These appear to be the best two-wiper patterns available, in view of the restrictions imposed by the center-post. Scale 1:8.

"Study is needed to provide blade of extreme curvature"



(a) Hypothetical asymmetric pattern with pivots shifted downward from the windshield edge to permit conventional (fixed-angle) wipers to clear flush to the left edge and bottom simultaneously. Left side: pivot 5½" down and 22" out from center, blade 15" long. Right side: pivot 5¼" down and 5½" out, 17" blade. The sweeps are shortened, with equal angles.



(b) Top-mounted asymmetric pattern with variable-angle wipers. The pivots are held close (1½") above the windshield edge, 18½" out from center on the left and 7" out on the right, so that the left-side wiper can clear flush to two edges, and the right-hand one covers the maximum area while clearing flush to the center-post, with the aid of the variable blade angle. Sweeps are nearly equal, and longer than above.

Figure 15. Other Possible Asymmetric Wiper Patterns for a Divided Windshield: drawn for the 1950 Plymouth P-20. In these patterns, other approaches are considered in carrying out the principle, illustrated in Figure 14, of using an asymmetric arrangement to obtain the best clearance toward the left on each half of the windshield. Although fairly good clearance is achieved in (a), it is probably not practical to locate pivots so far from the windshield. The top-mounted pattern is the best such achieved in this study, even with variable-angle wipers (cf. Figure 7), but is considered inferior to that of Figure 14-b. Wipers shown in "parked" position. Scale 1:8.

Table III. Total plane angles for various glass areas on a 1950 Plymouth sedan (with divided windshield), as measured in the horizontal plane for drivers of median sitting eye-height.

Horizontal Plane:	*Cleared (total)* Standard Wipers	Proposed Pattern	Windshield: Total	Total Glass Area
Angle—total	56°	71°	91°	269°
(Fraction of circle)	(.155)	(.197)	(.253)	(.747)
% Clearance: Windshield	61.6%	78.9%	——	——
% of Total Glass Angle	20.8%	26.4%	33.8%	——

Despite the foregoing accomplishments, this investigation of windshield wipers is not considered to be completed. Fully satisfactory solutions have not yet been developed for certain windshield designs, including especially the full "wrap-around" type used on automobiles in current production, which presents a most difficult problem. The small areas at both edges outside the regions of sharp curvature are almost impossible to reach with wipers which also clear more central regions, unless a new blade capable of extreme curvature is designed; and it might prove necessary to use an extra, separate wiper for each of them in an arrangement totaling four or five wipers. Alternatively, study has just been started of another development which might offer a practical solution, should it prove feasible. Nevertheless, a number of conclusions have been demonstrated:

(a) The variation in size and shape between the windshield of different vehicles is so great that no one wiper arrangement can give the simplest satisfactory solution in all cases.

(b) Three wipers of conventional (fixed-angle) type are generally required to give an adequate pattern on automobiles, but the specific arrangement chosen must depend on the windshield design and the restrictions imposed on pivot location.

(c) By means of the variable-angle arm, however, an adequate solution can often be achieved with a two-wiper arrangement—depending on the windshield. Shifting pivots away from the edge could help further.

(d) With variable-angle wipers, a single basis arrangement of three wipers has been developed which can be adapted to give a satisfactory pattern on a very wide variety of one-piece windshields, with pivots located symmetrically at the bottom.

(e) Such a three-wiper pattern has been shown to constitute a significant improvement over the inadequate clearance from the standard arrangement of two conventional wipers.

(f) A variable-angle wiper of simple construction can be developed with design changes from the conventional type in the arm only, which could replace the fixed-angle arms on vehicles now in service without other modifications, and would often improve the patterns to some extent in such use—provided that the limiting stops be adjusted properly for control in each specific application.

(g) Engineering attention is recommended on this general problem to obtain windshield wiper arrangements providing at least adequate patterns on all vehicles considered for procurement, by adapting appropriate solutions to each specific case. To this end, specifications should be adopted for maximum operational safety to require clearance of all critical and sub-critical areas of the windshield, including the critical area which extends to the left edge.

(h) It is strongly recommended that the engineering development of production models be initiated at once on the variable-angle wiper, to permit its large-scale manufacture and procurement for immediate use on existing vehicles of many types, where suitable, as well as for application in improved wiper arrangements whenever they can be provided.

SEAT BELT ACCEPTANCE SURVEY

Conducted April, 1956

Mid-States Freight Lines, Inc., Chicago

A. E. Mayerhofer,
Director of Safety & Personnel

Safety Belt Acceptance Survey

During the early part of 1955, the Mid-States Freight Lines, Inc. Safety Department began to give serious consideration to the use of the aircraft type safety belt in tractor-trailer equipment as a possible means of preventing severe bodily injury in serious overturn or collision accidents. This department was most interested in studying the use of such device to eliminate projection of the driver from his seat in the so-called "popped door" accidents which often result in fatal injuries. Two other elements were to be brought under study, firstly, the usefulness of the belt to steady the driver in trying to avoid an accident by violent movement or change of direction, and, secondly, the usefulness of the device to add to the comfort of driving over long hours by acting as a support.

It was decided that a survey of driver acceptance should be conducted before any further recommendations were made to the management for the pilot arrangement and the initial purchase of the equipment for testing in one area.

The survey was begun by the installation of a mock-up conventional tractor seat of the adjustable type upon which was affixed the various type safety belts available by both aircraft and automotive suppliers and included both the presently manufactured harness, or parachute type belt, and newly designed nylon seat belts of light weight construction. The purpose of such mock-up was to familiarize driver personnel with the different kinds of belts to be covered in the survey and to give them a chance to try the device at their leisure and discuss it with other driver personnel. It was our opinion that the employes would be in a better position to state an opinion after a reasonable time of exposure to this new idea among commercial interstate carriers and the plan was quite successful in drawing out certain definite conclusions.

After several weeks of testing and promotion, and after all drivers had had the opportunity to use the belts, a survey report form was given to each over-the-road, heavy equipment operator, seeking his opinion as to whether or not this accessory would be accepted and used by driver personnel. The response was immediate and satisfying.

The results and conclusions not only proved interesting but were of vital importance in the determination of further investigations into the future development and use of this very important safety device in the motor carrier fleet.

Results:

(I)

Only 15 per cent of the group had ever seen a safety belt in operation on either commercial or non-commercial vehicles.

(II)

About 24 per cent, or nearly ¼ of the driver group felt that the shoulder support type belt would make driving more comfortable, while 42 per cent took the negative view, and the remaining 34 per cent could not differentiate. Fear of entrapment and fire was the most prevalent cause of rejection of the parachute type harness so that the simple lap belt would appear to be most acceptable for this use although not the safest belt available.

(III)

In regard to the use of the belt to prevent bouncing and for use in stabilizing the driver, 23 per cent felt it would be beneficial. Thirty-five per cent felt it would be of little practical use for this purpose and the remaining 42 per cent were undecided.

(IV)

Eighty per cent were positive that the safety belt would serve its main function in preventing the driver from striking the windshield or other objects in the cab in the event of heavy crash impact. They were particularly selective in choosing the shoulder type harness over the ordinary cotton or nylon web lap belt in this regard. Only 20 per cent were of the opinion that it could not serve its function. It must be noted that all drivers had a definite conclusion in this regard.

(V)

Eighty-one per cent of the group were certain that the belt would retain the driver in the seat if the tractor doors were opened by impact. Eleven per cent were of an adverse opinion for reasons unknown and the remaining personnel were uncertain.

(VI)

Fifty-seven per cent were willing to try the safety belt on a trial period if it was provided. Thirty-three per cent stated that they would not participate. The 10 per cent remaining would not commit themselves.

(VII)

How many employes felt that we should install this

safety accessory in our equipment? Only 22 per cent gave an affirmative reply! Exactly the same number had a negative viewpoint. The remainder were uncertain!

(VIII)

The next area was of equal importance to this firm and was extremely disappointing to the Safety Department. How many transport operators would use the device if it was installed in our power equipment? Thirty per cent felt they would use it. Forty-two per cent would not use the device, and the remainder—28 per cent—wanted more time to acquaint themselves with the belt and its use before making a definite commitment one way or another.

(IX)

Only 33 per cent were of the opinion that the belt would do the job for which it was designed. Nineteen per cent felt it was worthless or of very limited use. The remainder —48 per cent—almost half the entire group, couldn't make up their minds.

(X)

The question was then asked as to whether or not we should continue our studies and investigations in this matter? It was most gratifying to receive more than 50 per cent of the total group's affirmative replies in this regard. About 24 per cent were of the opinion the project should be abandoned and the remainder were of the opinion that they could not answer the question fairly as of that time.

(XI)

In regard to comfort in wearing the belt, 34 per cent were of the opinion it would be a hindrance or even unsafe to wear. Twenty-six per cent felt it would be comfortable if properly adjusted. The remainder felt they could not give an opinion at this time.

(XII)

The next area investigated brings forth a conflict in driver reasoning. The question asked deals with the fear of the driver in unfastening the belt in case of fire or imminent danger of fire or explosion. Twenty per cent of the group thought such belt, because it could not be unfastened quickly would be a hazard. About 50 per cent were of the opinion that this did not constitute a problem! Thirty per cent could not answer the inquiry with any real assurance. (Refer to heading VIII—page 29 and note that 42 per cent would not use the device if provided so that other unknown factors, most probably unfamiliarity with the safety belt or lack of experience in its use, plays a very important part in adversely influencing the driver's opinion.)

(XIII)

Only 15 per cent thought that the price of such safety accessory would be prohibitive. Thirty-six per cent were not familiar with its cost. The vast majority of the group felt the price was not of any great importance to them. (This was quoted at $10 to $15 per unit.)

(XIV)

The last area was aimed at leased operators in order to obtain their reaction towards purchasing the device if not provided by the firm. It was surprising to note that over 40 per cent would be willing to do so. Twenty per cent would not purchase the belt and the remaining 40 per cent would not commit themselves at this time.

Conclusions:

We believe that this survey has given us the answers to some very important questions and has been of great value in determining the next step in the promotion of this most useful and effective safety device.

The survey indicates a grave need for effective publicity by the manufacturers in selling this item to the public. It is difficult to imagine that only 15 per cent of the commercial driver group of a large motor carrier fleet, as professionals, have ever seen a safety belt in use! Most drivers are unquestionably ignorant of the advantages of the safety belt and a good deal of training and promotional activity will be required before they are ready to accept it.

Fear of being trapped, for instance, because the belt cannot be unfastened rapidly is still one of the principal causes of rejection by the commercial driver. Yet the vast preponderance of driver personnel contacted were certain that the belt would be helpful in preventing death or serious personnel injuries by immobilizing the occupant. It is evident that the public has not been sold on this idea and the trucking industry especially needs indoctrination. Almost to the man, the professional driver has felt that the straps would retain him in case of doors popping open, or hold him in the seat in case of a pile-up and turn-over. Yet there is baseless fear by the driver in accepting the device.

It is our firm belief that this safety device is acceptable and will play an important role in future injury protection by (1) immobilizing the driver so that he will not strike the windshield in case of collision, (2) retaining the driver in case of doors popping open and preventing the occupant from being thrown to the highway, (3) stabilizing the driver so that he can steady the equipment in avoiding accidents or after the initial impact of collision in order to better control the vehicle, (4) will serve as an effective resting device as the driver can lean into it, making driving more comfortable.

There are many instances in our experiences which demonstrate the value of the safety belt, of which several may be cited:

Accident Case A—Driver operating on slippery highway at reduced speeds. Woman driving car with five children as passengers turns from side street at a speed too fast for existing conditions, skids on ice directly into the path of oncoming vehicle. Tractor driver cuts sharply off highway, unit jack-knifes with such violence, driver is catapulted through right door, breaking off door and hinges, suffering grave injuries. Safety belt would have retained driver.

Accident Case B—Driver approached dead-end highway in rainstorm. Flare pots extinguished so no warning present. Cut over sharply to avoid abutment and unit overturns, tractor lands on top. Driver's hip fractured when body struck gear box. Safety belt would have supported him and prevented serious injuries. Safety gasoline tanks prevented spillage. No fire occurred.

Accident Case C—Driver avoids vehicle in wrong lane, on curve, by driving into ditch, strikes tree. Driver's head, face, and chest severely injured when he strikes steering wheel and windshield. Safety belt would have retained the driver and alleviated degree of injury.

Accident Case D—Driver strikes deep hole in pavement on overpass. Tie-rod broken in steering, unit jack-knifes and strikes abutment. Driver catapulted out of cab 30 feet to pavement below and is fatally injured. Safety belt would have held driver in seat when door popped open.

Accident Case E—Driver avoids vehicle in wrong lane on curve and grade, strikes guard rails, thrown out of control. Strikes rear of stopped tractor-trailer unit ahead. Doors are thrown open by impact. Driver is thrown out of cab and trailer turns over on top of operator, killing him instantly. Driver thrown to side of tractor cab by initial impact but could not regain control causing second and fatal collision with standing vehicle. It is believed that this accident could have been prevented by a safety belt inasmuch as it would have immobilized the driver after the first collision, which was survivable, and would have also retained the driver within the equipment of the unit after the second collision which was also of a survivable nature.

The records of the motor carriers are replete with many cases of this nature which clearly establish the value of the lap belt. Some carriers have already furnished it and numerous other truck lines are seriously considering such safety device as standard equipment on all new units. It is our opinion that with the proper promotion and indoctrination of driver personnel, particularly the heavy equipment transport operator, the safety belt will be accepted as standard safety equipment in the same manner as flare pots, fusees, and other signal devices now required on equipment operating in interstate commerce. The degree of acceptance will depend solely upon driver education and re-education as the principal block to immediate acceptance is simply ignorance of the basic safety factors involved in crash impact or rapid deceleration.

There is no question in mind that the safety seat belt will be received favorably but the manufacturer and the management will have to sell it to the driver. A joint venture in this regard would in time pay handsomely in reduced personal injury claims and should be exploited to the maximum degree. The saving of human life and the pain and suffering of crippling injuries to operating personnel, of course, is immeasurable.

MID-STATES FREIGHT LINES, INC.
5200 SOUTH PULASKI ROAD
CHICAGO 32, ILLINOIS
S U R V E Y
"USE OF THE SAFETY BELT TO PREVENT INJURIES"
PREPARED BY THE SAFETY AND PERSONNEL DEPARTMENT

INTRODUCTION

It is surprising to note how few drivers realize that an amazingly low percentage of fatal and severe personal injury cases result from structural collapse of the equipment.

About 65 per cent occur when the victim strikes objects within the vehicle by the impact when the vehicle is stopped suddenly by collision and the passenger's body is thrown forward. Head injuries stand foremost in the cause of death. Such injuries also stand high in cases of turnover or skids.

About 20 per cent of all fatalities or serious injuries resulting from vehicular accidents are caused by the doors "popping" and the victims are thrown to the pavement or to the ground.

Only 10 per cent to 15 per cent result from structural disintegration or collapse.

It is, therefore, reasonable to assume and experiments have proven conclusively that the safety belt, if worn at time of collision, could have prevented the vast majority of deaths and crippling injuries.

These are established facts.

We would like to have your reaction and would appreciate your co-operation in indicating your views hereon. This will play an important part in future plans in the use or rejection of this safety device.

QUESTION

1. Have you seen the safety belt in operation on commercial equipment? 6 Yes, 25 No.

2. Do you believe that a "parachute" type harness, properly adjusted, would serve as a resting device and make driving more comfortable by permitting the driver to lean into it? 6 Yes, 11 No, 14?

3. Do you believe that the harness would be desirable in preventing "bouncing" when traveling over rough or uneven pavement? 8 Yes, 5 No, 18?

4. Do you believe that such shoulder and chest harness would protect the driver against impact with windshield, sharp objects within the cab, steering wheel, etc., in case of collision or emergency stop? 25 Yes, 6 No.

5. Do you believe it would protect the driver from being thrown out of the vehicle by "popped" door catches? 25 Yes, 4 No, 2?

6. Would you desire to try using a safety belt as an experiment? 17 Yes, 12 No, 2?

7. Do you believe we should equip our tractors with safety belts? 9 Yes, 7 No, 15?

8. Would you object to using the safety belt if it is comfortable and if such device was provided for your safety? 11 Yes, 10 No, 10?

9. Do you believe that it will do the job that the designers and engineers claim it can do for you? 10 Yes, 6 No, 15?

10. Do you believe that this project should be pursued further by the Safety and Highway Departments? 11 Yes, 10 No, 10?

11. Do you believe these belts are uncomfortable? 14 Yes, 7 No, 10?

12. Do you believe that they are unsafe because you couldn't unfasten them quickly? 7 Yes, 15 No, 9?

13. Do you believe they would cost too much? 7 Yes, 10 No, 14?

14. Would you purchase such a belt if available at a reasonable price? 10 Yes, 9 No, 12?

Printed in U.S.A.

JUNE, 1957

Leading Sports Figures

tell you their secrets of

CHAMPIONSHIP PERFORMANCE

in these new Safe-Driving Films

1 SKILL IS YOUR BUSINESS. In the first film, the late Wilbur Shaw, then President of the Indianapolis Speedway, illustrates that with relaxed coordination, skillful driving can become automatic — shows how to maintain professional driving skill day after day, regardless of adverse traffic conditions or unexpected emergencies.

2 THE CHAMP BECOMES DEAF AND BLIND. Lloyd Mangrum, one of golfdom's most consistent money winners, shows that the ability to concentrate, in spite of distractions, is one big difference between a duffer and a champion. The concentration of a golf professional, Wilbur Shaw points out, is similar to that required of a professional driver.

3 NINETY-DAY FLASH. Shows through the eyes of Paul Richards, former White Sox Manager, how a ball player's slightest miscalculation, repeated often enough, can become a disastrous habit. Wilbur Shaw completes an analogy, with the visual account of a driver who developed, a "slight" habit that eventually proved fatal.

4 WATCH YOUR HANDICAP. "Drivers, like professional bowlers, can handicap their performances through lack of sleep, improper food and health habits," says Ned Day, long-time bowling champion. Film stresses the important correlation between clean living habits and clean driving records.

5 TAKE A LOOK AT THE ODDS. This concluding film in the series explains why the right safety *attitude* is so vital in the prevention of accidents—presents a dramatic sequence in which a driver's attitude prevents what could have been a fatal accident.

Each film is in full motion and sound and runs for 10 minutes. Available individually at $65.00 for black and white and $105.00 for color or on a rental basis of $10.00 for black and white and $20.00 for color.

NATIONAL SAFETY COUNCIL
425 North Michigan Avenue, Chicago 11, Illinois

Please send ____ copies of Professional Driving Series ☐ Color ($485.00) ☐ Black and White ($300.00) to the undersigned. Check or money order enclosed.

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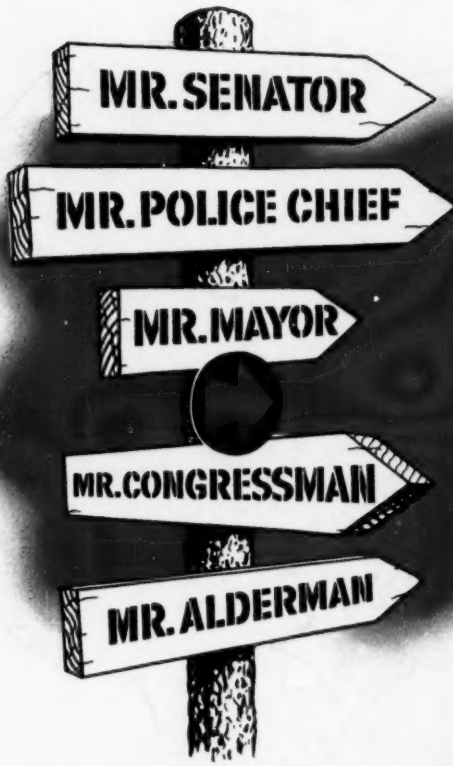
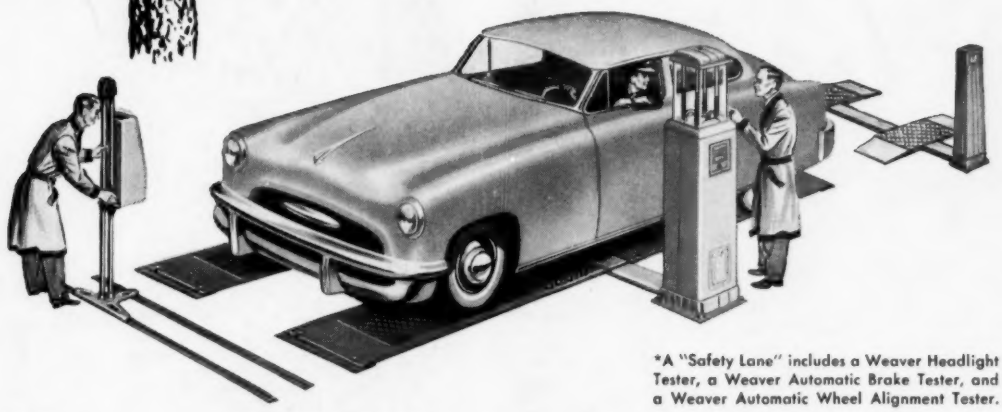


What direction is your city or state taking to reduce traffic fatalities?



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